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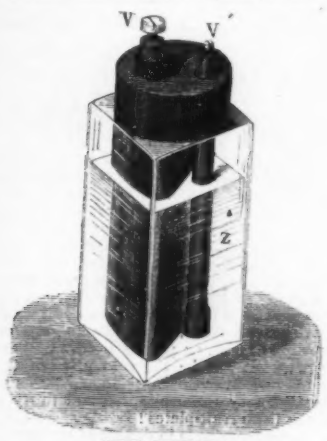
NEW SESQUIOXIDE OF IRON AND CHLORHYDRATE OF AMMONIA BATTERY.

M. GAIFFE has recently devised a new battery, which, while in several respects resembling that of Leclanché, is claimed by its inventor to be considerably more economical. It is composed of an exterior glass vessel, a prism of carbon, C, containing in its pores sesquioxide of iron, and an amalgamated zinc rod, Z. A mastic cover closes the cup and prevents evaporation, the only opening being that for the admission of the rod. The screws, V V', are for the conducting-



NEW BATTERY.

wires, and the exciting liquid is a solution of chlorhydrate (muriate) of ammonia.

The battery, so far as its action is concerned, is identical with that of Leclanché. Thus, when the circuit is closed, the chlorhydrate of ammonia, or chloride of ammonium, attacks the zinc, and forms with it a double chloride of ammonium and zinc; the ammonium set at liberty decomposes the sesquioxide of iron, and with one part of oxygen forms free ammonia, which is dissipated. No action takes place except when the circuit is closed. The battery has a constancy and an energy relatively large (its electro-motive force is equal to $\frac{14}{15}$ of a sulphate of copper couple), so that it is well suited in its smaller sizes for medical or electric signal uses. In larger dimensions it is claimed to be adapted for telegraphic and industrial application.—*Science Record*, 1876.

IMPROVEMENT IN THE MANUFACTURE OF ANTIQUE COLORED GLASS.

By J. BAKER, New-York City.

THE object of the author is to provide a method by which colored glass for ornamental purposes for church and other windows may be furnished, and the same degree of brilliancy and semi-translucency obtained, as is found in the stained-glass windows of the mediæval cathedrals and churches.

The author takes fused glass on the rod, and produces, by turning the same simultaneously with blowing through the rod, a glass plate of disk or oval shape of the required size, which is to be cut into smaller pieces for use.

The stained glass hitherto employed is rolled, and has an even color throughout, which imparts to the pictures or ornaments made therewith a too regular and monotonous appearance, without variety and life in the same.

By the author's method of turning or "spinning" the fused glass of any color or tint into disk or oval shape, concentric streaks are formed around the bull's-eye at the issuing-orifice of the rod, while at the same time different shades are formed by the slightly-diminishing thickness of the glass disk from the centre toward the circumference. This admits of bringing a certain shading into the glass pieces employed, which increases the effect of the same to a large extent.

The peculiar concentric structure of the glass disk obtained by simultaneously blowing through the rod and turning the same in one direction produces a brilliant sparkle and semi-translucent effect which approaches the warm and effective coloring of antique glass.

NOVEL FRUIT PRESERVING-JARS.

By T. J. PRICE, Macomb, Ill.

THE jars are constructed out of potter's clay in the usual manner of constructing common earthenware, and then baked in a kiln sufficient to make a durable ware, without any substance applied to them to form a glaze. When they are thus made the body of the jar is porous. They are then placed in a bath-tub containing a strong salt solution. They remain in the bath a sufficient length of time to fill the pores in the jars with the salt solution. The jars are then taken out and allowed to dry. They are then lined on the inside withlime, which is made in a plastic state with water, and applied to the inside of the jar in any convenient manner.

The object of filling the pores of a porous fruit-jar with a salt solution is to produce a cold and even temperature inside of the jar, as the jars when thus prepared will absorb moisture from the air sufficient to keep the body of the jar in a damp, moist state, which moisture and salt in the pores of the jar produce the cold and even temperature inside of the jar, and also supply the fruit with sufficient moisture to keep it from wilting.

The object of lining the inside of the jar with lime is to prevent any mold or fungous matter from germinating on the fruit. After the jars are filled with fruit, they are placed where they will not freeze.

AN archæological discovery has just been made at Jerusalem. About 150 yards north of the Damascus gate two rock-cut burial-chambers have been discovered 12 feet under ground. In the larger chamber is a large stone chest, cut from a single stone, containing human bones. It is suggested that this is the burial-place of Eudocia, who died in Jerusalem about 461. The Church of St. Stephen is supposed to have stood near this spot, if not over it. Underneath the smaller burial-vault is another excavated to the depth of ten feet below the first. The digging of a cistern led to this discovery.

ELECTRICITY FOR ANNEALING METALS.

By J. H. WARRINGTON, Camden, N. J

THE object of the invention is to soften or temper wire or other thin metal strips, by causing currents of electricity to impart the heat required; the application of the invention to wire-drawing apparatus being represented in the accompanying drawing.

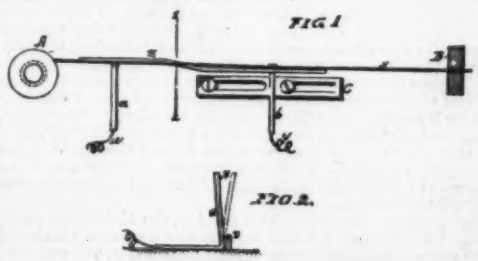
Fig. 1, plan; Fig. 2, vertical section. A, reel of wire; B, a draw-plate.

Owing to the condensation and consequent hardening of the metal, it is necessary, after the wire has passed through one or more draw-plates, to anneal it, for which purpose it is customary to anneal the coil by the usual process of first heating and then slowly cooling. To avoid this tedious operation, I heat the wire while it is passing through the drawing-machine by an electric current, transmitted through the wire between two fixed poles, in contact with which the wire passes as it is being drawn. These poles consist of a pair of insulated metal bars, *a b*, arranged between the draw-plate and the reel, and possessing a slight elasticity, which maintains them in contact with the wire; and to these bars are connected wires *w y*, attached to the opposite poles of a battery, or other galvanic or electric apparatus.

That portion of the wire between the bars *a b* will serve to conduct from one bar to the other a current, which will impart to this portion of the wire a temperature varying with the intensity of the current; and, as the wire is in constant motion, and in contact with the bars, it must necessarily be heated and softened before it reaches the draw-plate, thereby obviating the necessity of annealing the coils of wire from time to time.

In wire-drawing it is usual to place on one bench or frame a succession or series of reels, draw-plates, and drawing mechanism, in which case one battery may be used in connection with the different drawing appliances.

It is important that the temporary disuse of one drawing-machine should not disturb the action of the electric current in the others. In order to provide for this the wire is made to pass from the reel in an indirect course, the wire passing on one side of the bar *a* and on the opposite side of the bar *b*, and the tension on the wire tends to maintain both bars free from contact with a rod, Z. Should the wire break, however, or the drawing mechanism be out of use, both bars *a* and *b* will, owing to their elasticity, be brought in contact with the rod Z, which will carry off the electric current without disturbing those currents which are employed in connection with other drawing-machines.



MACHINE FOR ANNEALING METALS.

Either or both of the bars *a* and *b* may be secured to an adjustable plate, C, or may be made otherwise adjustable, so as to regulate the distance between the bars, as the intensity of the current or the thickness of the wire may require.

Although I have described my invention as applied to the softening or annealing of wire in wire-drawing apparatus, it will be apparent that it may be employed in tempering thin strips of metal, or in apparatus for hardening wires or strips of steel, such, for instance, as umbrella-ribs.

A NEW ELECTRIC MACHINE.

IN the accompanying illustrations is represented a new magneto-electric machine devised by M. Alfred Niaudet, the construction of which will be understood from the diagram Fig. 1. Twelve electro-magnets are secured to a vertical disk at right angles to its face, and are connected together exactly as are the elements of a galvanic battery. The disk is disposed relatively to the poles of the magnet, as shown in Fig. 2, and may be rotated in the direction of the arrow. When the disk is thus turned, there is developed in each coil as it leaves the pole N, Fig. 1, a current, of which the positive pole terminates in advance of *a* + and the negative pole in rear of *b* —. This current maintains the same direction while the coil passes from pole N to pole S, since the approaching of pole S has the same influence as the separation of pole N, and the two effects are concurrent. But, during the second half revolution of the coil under consideration, it separates from pole S and approaches pole N, and consequently the direction of the current is inverse to that which it assumed during the first half of the movement, as marked by *a*— and *b* + at the front and rear terminals of the coil.

Knowing then what takes place in each coil, it is easy to understand the action of the assemblage of twelve. Considering at any moment the coils placed on the right of the

FIG. 1.

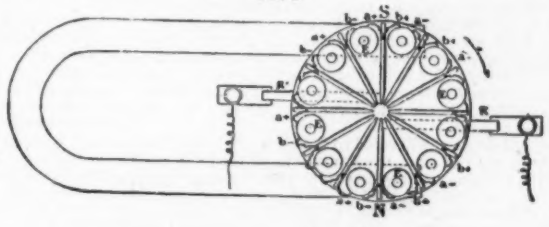
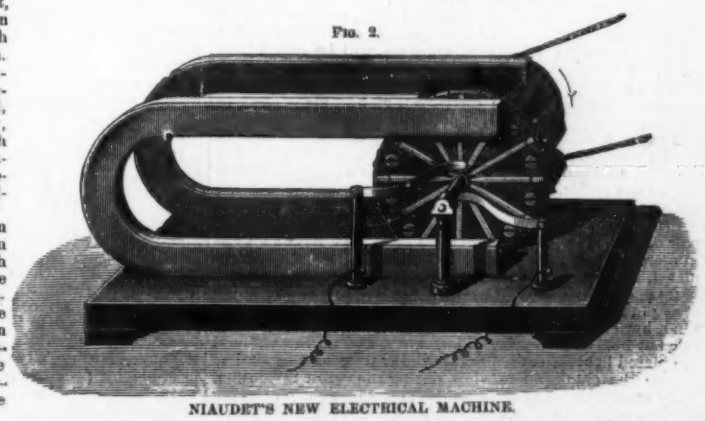


FIG. 2.



NIAUDET'S NEW ELECTRICAL MACHINE.

line of poles, it is evident that all are traversed by currents of the same direction, which are connected for tension, in similar manner, to six elements as ordinarily disposed in a galvanic battery. At the same instant, the coils placed on the left of the polar line are traversed by currents of like direction also coupled for nsion. Furthermore, the sum of the currents on the right is manifestly equal to the sum of the currents on the left; but the direction of the currents on the right is inverse to that of the currents on the left. The group of twelve coils may thus be compared to two batteries of six elements each, opposed one to the other by their poles of like name. Now, if an electric circuit is placed in communication by its two extremities at the points where these two sets of elements are opposed, it is traversed simultaneously by the currents of the two batteries which are thus associated for quantity.

In order to collect the currents developed in the machine which we have described, switches R, Fig. 1, are established which touch the points of interconnection of the coils at the moment of the passing of the latter by the line of poles. The continuity of the current results from the fact that the collecting switches, before leaving any one of the radial connecting pieces, Fig. 2, already are in contact with a following one.

It will be seen that the machine produces continuous currents in manner somewhat similar to the Gramme apparatus. While the latter is in many respects the superior, and is so admitted to be by the inventor of the present device, it is believed that the Niaudet machine will find much useful employment in cases where a current of very high tension though of little quantity is required.

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THE INTERNATIONAL EXHIBITION OF 1876.

GENERAL VIEW OF THE SITUATION.

No. I.

THE grand chaos which, for the past few months, has presented itself to the eye of the visitor to the Centennial grounds, is slowly but surely crystallizing into definite form and proportion, and, as the centres of development become more numerous, the daily progress made increases in a geometrical ratio. This is nowhere more apparent than in the different branches coming under the immediate direction of the Machinery Bureau. Even now the casual visitor may begin to form something of an approximation towards a correct conception of the magnificent *tout ensemble* which will greet his eye on or about the 10th of May next. From this time forth a general record of the progress made from week to week can not fail to be of much interest to all who expect to visit the completed exhibition; while to those who may be so unfortunate as to be deprived of the opportunity to behold the vast congregation of objects already booked for position in the Exhibition, the result of man's industry and handiwork from all parts of the globe, such a record will serve in some degree to convey a conception of what the more fortunate will really enjoy in the actual inspection of the objects themselves, and will prove a source of gratification and information which will compensate, some little at least, for their enforced absence.

The new building to be devoted to the shoe and leather industry has, during the past week, made rapid progress, and the close of the coming week will doubtless find the major part of the framing in position. This building will occupy the larger part of the rectangle bounded by Elm avenue, Machinery Hall, the hydraulic annexe to the latter, and the offices of the Board of Finance and will be 312 x 160 ft., with an extreme height of 60 ft. The actual floor space to be devoted to the use of exhibitors, exclusive of passages, will be over 26,000 sq. ft. A large proportion of this space will be occupied by exhibits in which the various processes incidental to manufactures of leather will be carried on, and in many cases in all completeness and detail, which will without doubt render this one of the most interesting and instructive branches of the Exhibition. It will be fitted with about 300 ft. of line shafting, and derive its motive power from a separate steam-engine and boiler, the latter located in a special boiler-house not a part of the Exhibition building.

In the main Machinery Hall the foundation for the huge pair of Corliss engines, which is to furnish power to all exhibitors not requiring steam direct from the boilers, is completed, and a portion of the castings placed. The principal parts of one engine are in the building, and the others are to arrive in a few days. These engines are of the condensing kind, have cylinders 40 inches diameter, 10 ft. stroke, and are rated at 1400 horse power. They are "beam engines," and are placed in sufficient height above the floor of the Hall to expose the crank-pin to view during the entire revolution. They are connected at right angles to a single shaft carrying a cut mortise gear-wheel of the following magnificent proportions: outside diameter, 30 ft.; face, 24 inches, and having 216 teeth, with a pitch of 5.183 inches. This wheel engages a cast pinion, also cut, of 10 ft. diameter, which is situated principally below the floor level. In a covered trench, parallel with the axis of this pinion, extends in either direction a line of shafting diminishing from 9 in. to 8, 7, and 6 inches, respectively, which, by means of four trios of mitre-bevels transmits to four 6-in. shafts at right angles, leading in either direction to walled pits under heavy standard frames, which carry the driven pulleys on the ends of the overhead shafting. The whole of this shafting, including the 12 bevel-wheels, lies in covered ways or trenches and will be hidden from view. The visitor will see these colossal engines, as it were, unconnected to any absorber of power, standing in the centre of the large space formed by the intersection of that passage through the building called South avenue and the Transept, with no more in immediate view than itself with its great gear-wheel and the upper part of its pinion; while at eight separate points in the Transept will be seen a corresponding number of driving-belts, 30 inches wide, rising from the floor to the overhead pulleys.

The mitre bevels referred to above are all of iron, and cut in the cutting-engine to geometrical exactness, a feature not to be found in cut bevels until quite recently. Their bearings and yokes are placed upon foundations which are designed to prevent the disagreeable noise usually attending the running of such wheels when both or all are of iron or metal. The character of these foundations, together with the correctness with which the teeth of the wheels are cut, will no doubt render them entirely unobjectionable in this respect. These bevels are 5 ft. 10 in. in diameter.

The engines will make about 35 revolutions per minute, which will give 105 turns to the pinion, and therefore to the eight driving-pulleys. These pulleys are seven of them 8 ft. and one 9 ft. in diameter. The driven pulleys have diameters such that the various lines of shafting overhead are run at 120 and 240 revolutions per minute. The total length of shafting in this building, exclusive of that in the annexes, will exceed *one mile*, and it will be quite an interesting experiment, which no doubt will be had, to ascertain the work absorbed in the friction of the unprecedented amount of rubbing surface contained in the vast number of journals appertaining to it.

Some very interesting data may be obtained by disconnecting at various points, running at one time the whole and at another portions only of the lines; running the whole with all counter-shafting in motion, and again with all loose pulleys and their belts in motion. Every thing will be on so vast a scale and the machinery of so varied a character, that, conjoined with the indicating of the engine, or the use of the dynamometer, it will afford an opportunity to arrive at some frictional data not to be had in any other way, and of the most reliable nature.

The steam required for these engines will be generated by 20 vertical tubular boilers, set in battery in brick-work. They are each 49 inches in diameter, and 14 ft. long; and simple cylinders in form, with fire tubes passing through from end to end. This series of boilers constitutes what may be called one enormous sectional boiler, and may be considered as safe beyond peradventure. One element of safety in the whole arrangement of them lies in the fact that they are to be situated mostly below the surface of the surrounding grounds, which in case of the rupture of one of them gives almost absolute protection to the contiguous buildings. They are to be placed in a frame building of ornamental design, uniform with Machinery Hall, now nearly completed, situated between the Shoe and Leather Building and the hydraulic annexe of Machinery Hall, from which an underground passage will lead from the fire-room to the engine-room or platform in the main hall. This boiler-house is 78 x 40 ft. in the clear, and the boilers will occupy three sides of the rectangle formed by the foundation walls, the floor of the fire-room being about 10 ft. below the level of the floor of Machinery Hall. The boilers are fired from the inside of the rectangle, while the flues occupy the outside, leading to two chimneys, each 100 ft. high, of very elegant design, and placed at each of the two angles contained between the three sides of the rectangle. Each chimney receives two main flues, and each of these in turn receives the branches from five of the twenty boilers. The boilers are all on the ground and will soon be in place. I shall enter more into the details of these engines and boilers hereafter; and next week will have something to say about the progress made in the hydraulic annexe.

The first appearance of an exhibit in place on the floor of the main Machinery Hall is made this week, and Messrs. Aveling & Porter, of England, are entitled to the honor of "first blood," whatever may hereafter become of the "knock-downs," in having two of their combined road locomotives and steam-cranes standing in defiant invitation to their competitors. It is to be regretted that there are not more exhibits making their appearance by this time, and fears may reasonably be entertained that, unless greater expedition is used in getting the preparations under way, and the machines to be exhibited on the ground, than has up to this time been had, exhibitors will find themselves laboring under disadvantages in placing their goods, in the crowd and hurry of the last few days, within which they are limited, which may now easily be avoided. It is to be hoped that they will keep pace with the preparations of the commission, now that the principal buildings are ready for the reception of goods, and thus aid in having for once, in the history of such exhibitions, every thing in readiness at the appointed day. Nothing, however, but promptness on their part *now* can bring about this much-desired consummation.

One of the Messrs. Appleby's (London) steam-cranes is on the track of the hall to be used in the transportation and erection of machinery. It is a powerful and admirably-proportioned machine; and, if the much-suggested experiment of lifting one's self by the boot-straps were ever to be possible, we might expect to see this machine turn upon and lift itself from the track by simply hooking on somewhere in the vertical line through its centre of gravity. J. T. H.

PHILADELPHIA, January 31, 1876.

SUNDAY AT THE CENTENNIAL.

ON a recent pleasant Sunday, the crowd of visitors to the Exhibition grounds was roughly estimated by a Philadelphia newspaper as anywhere between one hundred thousand and two hundred thousand. All the street cars on the various lines leading to the Exhibition grounds were overloaded going out, up to late in the afternoon, and were then quite insufficient, with all their overloading, to carry the people to the quarters of the city they were seeking. All the avenues, passable by pedestrians, among the Centennial buildings, were busy and black with people. If such a multitude is gathered there from Philadelphia alone, long before the Exhibition is opened, how much greater, it is asked, must the multitude be after it is opened, and when the people of all parts of the Union and of the world are assembled expressly to visit it? "There is no law to prevent their going thither, and if there were such law, it would be impossible to execute it. People will go to the Centennial grounds on every fine Sunday, and in greater swarms than they do on any other day of the week. Shall they be admitted to the Exhibition buildings, where they may occupy themselves in intellectual study, or be compelled to turn for amusement and refreshment to establishments outside of the grounds?"

When certain church papers raised a cry against the possible opening of the Exhibition on Sunday, the directors replied that it should not be and could not be, a State law forbidding the holding of shows on Sunday.

There will be nearly a month of Sundays during the period of the Exhibition. In view of the fact that to a large portion of the community, embracing those most likely to be benefited by the Exhibition, Sunday is the day they can best spare for its enjoyment—in thousands of instances, the only day—the wisdom of wasting all this precious time through deference to ecclesiastical prejudice is by no means clear. To those whose regard for Sunday is such that they would consider it sinful to visit the Exhibition that day, we would say, emphatically, *stay at home;* but do not allow your prejudice to bar the way to such a use of the day by those who do not regard it as sinful. If there was ever a time when the day should be "made for man," that time will be during the Centennial Exhibition.

So far from being closed on Sunday, the Exhibition buildings should be opened free that day to all comers. It should be made specifically the working people's day, and every inducement of cheap trains and other advantages should be offered to encourage the poor to come. Their presence there would not interfere in the least with the Sunday observances of Sunday worshippers; nor would it endanger in the remotest degree the moral well-being of the visitors themselves. On the other hand, to deprive them of the benefit of their only day of exemption from labor, would simply serve to heighten their dislike of ecclesiastical restraint.

But two reasonable objections can be urged against the opening of the Exhibition on Sunday: First, that it would be contrary to the organic law of the State; second, that it would deprive the exhibitors, officers, and employees of needed rest, and compel many of them to do what they are conscientiously opposed to doing.

To the first it may be replied that the law against Sunday exhibitions was not intended to cover occasions of this sort; and if it were, the general practice of the community has made it of no effect. The entire park is a public exhibition, which has never been closed on Sunday. If the law can tolerate an exhibition of beasts and birds in the Zoological Gardens, it is certainly setting the letter of the law above its spirit to condemn the exhibition of the world's products close by. Any objection to the exhibition of industries, machinery in motion, and so on, would come with ill grace from a State the smoke of whose furnaces goes up incessantly, one day the same as another.

The second objection is a more serious one. Still we think it could be easily obviated. No doubt some of the exhibitors would prefer to observe Sunday as a day of rest or religious ceremony. Nothing should be done to prevent their so observing it. But there are others who would choose to exhibit, and they should be equally favored, local customs and prejudices to the contrary notwithstanding. This is to be a World's Fair, not a Philadelphia show.

As for officials and attendants, the burden of Sunday service could be arranged so as to cause little, if any, hardship. There will be, of necessity, relays of attendants, no one set being sufficient for the night and day work required; and we should anticipate little trouble in securing all the help, or the extra help, required for Sunday opening among the regular employees, or by the appointment of Sunday servitors from the ranks of those who would have no conscientious scruples against Sunday labor.

ENGLISH PORCELAIN FOR PHILADELPHIA.

A CORRESPONDENT of the Philadelphia *Press*, writing from London, describes a collection of china-wares intended for the great Exhibition:

"Every variety of article and pattern is included in the collection, from immense rustic garden-seats to egg-shell coffee-cups and cashmere ornaments. The artists employed to paint vignette miniatures for fruit and dessert services and the splendid vases and trays are M. Solon, M. Marks, Royal Academician, and M. Mussill. From a number so varied and so large it is impossible to give a description of even all the most prominent articles, but there are some features that deserve special attention for their rare artistic merit. A neat little set of dessert-plates, each ornamented with an exquisite vignette portrait of a child, first attracted our party. The rim of the plate was fretted and gilded as if for a frame to the centre porcelain picture. Every face of the twelve was a distinct portrait, no two having the same shade of hair, expression of face, or pose of head. One greedy gentleman inquired what will be the sale price of these plates per dozen! 'Five guineas each plate, sir!' was the extinguishing reply. Fancy three hundred and thirty dollars in gold for a dozen little fruit-plates!

"Another dessert service is in danger of never reaching the Exhibition; it is just too lovely, the ladies say, to be packed out of sight long enough to cross the ocean. A complete series of Landseer's domestic subjects, 'Dignity and Impudence,' two little rascally pups, would tempt even a Philadelphian to turn Chinaman and eat them both off the plate they ornament. Next in order comes a series of placques or *trays* for mural decoration, representing the seven ages of man, painted in mediæval character, after original designs by Mr. H. T. Marks, Royal Academician. These royal specimens of fine-art pottery are suitable for the dining-saloon of a club-house, and I prophesy they will never leave Philadelphia if they ever reach there. A grand Prometheus vase is remarkable for its size and the perfection of form and rich turquoise color of the urn. The metallic decoration surmounting the urn of chained figures in mailed shirts and all the metallic armor and accompaniments are finely worked up, resembling in every detail the most finished bronze and silver workmanship. Another pair of turquoise blue and gold vases, remarkably fine in ornamentation, is modelled after the old Sevres 'ship' vases, specimens rare and curious enough to occupy places in any fine-art museum. M. Mussill has excelled in the perfection of a splendid pair of vases, the pose and the treatment of the plumage of the life-size heron being extremely natural. On one, the heron sleeps, resting with one foot under his wing; on the other a limpid stream of water flows over the pinkish talons, reflecting sunlight glimmerings on the beautiful rose and pearl-shaded plumage. Pompeian vases with Cupid figures in pâte-surpâte, by M. Solon, are extremely beautiful, but to my fancy the 'Pilgrim vases,' by this same artist, are the gems of the collection. Modelled after the flask carried on the belts of ancient pilgrims, their designs are exquisitely fine. On a rich dark green ground of the highest polish a Parian figure of Fame is building her temple of cards. On the companion vase, Slander floats along on the breeze, and with one breath the frail Palace of Fame is blown to the four winds of heaven! Nothing more delicate in expression and finish of workmanship can be conceived than this ideal design. Oh! for her Majesty's opportunity to appropriate *that* pair of 'Pilgrim vases.' Messrs. Daniell & Son are not the only exhibitors in this line of earthenware, but represent very fairly the grade of British work in china and glass that will come to us from Scotland, Ireland, and England. The fact that the Queen makes special request to view this magnificent collection proves the valuation placed on it by English *connoisseurs*. It is only just to remark that the gentlemen in charge of it, who attend the Exhibition personally, are most anxious that the Philadelphians will appreciate their labor, expense, and artistic care in the execution of a task so delicate and difficult as the preparation and risky transportation of this costly fine-art pottery. I am confident they will have none of it to bring back to England."

BOREAS VISITS THE EXHIBITION GROUNDS.

THE mild and spring-like weather of January permitted the out-door work of preparation to go on as serenely as if it had been May. As a consequence, the hurricane of the 2d of February found a large number of buildings in various stages of incompleteness, and they suffered accordingly.

The first visit of Boreas was to the New-York State building, the framework of which was hurled to the ground. Few of the timbers can be used again. The Massachusetts and Connecticut buildings, and some other frame-buildings in process of erection, were likewise roughly handled, but being less advanced or less exposed, escaped with slighter injuries. Agricultural Hall, the only one of the main buildings not completed, suffered to the extent of several hundred dollars, owing to the contractor's over-confidence in the mildness of the weather. An unfinished tower was

toppled over, and in its fall made a hole in the roof about twenty-five feet square. Two other towers which the contractor had neglected to stay were thrown down, but did no further damage, and two more were shaken and slightly displaced, but can easily be restored to position. The United States Government building was partly unroofed, but not greatly damaged; and a section of the tin roofing of Machinery Hall was rolled up like a scroll, but the mischief was easily repaired before sundown. Considering the temporary purpose of the buildings, and the immense areas they presented to the hurricane, their ability to withstand so severe and unusual a test is a matter of surprise and congratulation. The skeleton work of a large hotel adjoining the grounds was blown down, and the other new hotels thereabouts were injured more or less, but none seriously.

EXHIBITION NOTES.

GOVERNOR HARTRANFT, of Pennsylvania, as commander-in-chief of the military forces of the State, has issued a formal order granting permission to all armed bodies of national guardsmen from other States to enter, pass through and remain within the limits of the commonwealth at will during the time of the holding of the Centennial Exhibition. The preparations making for military display at the Exhibition indicate that the art of defence will make a lively bid for popular favor in the very stronghold of the more peaceful industries. One of the most attractive as well as significant "exhibits" will be that of the Centennial Legion, to be composed of one veteran military organization from each of the original thirteen States. It will include ten companies of infantry, two of cavalry, and one of light artillery, who will join in celebrating the next Fourth of July at Philadelphia. The first suggestion of this legion was made at Bunker Hill on the last 17th of June by the Washington Light Infantry, of Charleston, S. C., and was seconded by the Boston Light Infantry and by the Old Guard of New-York. The State Fencibles of Philadelphia will represent Pennsylvania, and popular companies in other States are eagerly competing for the honor. Ten of New-York's best regiments will visit the Exhibition, and the Connecticut Brigade will spend two weeks there. The encampment of the West Point Cadets will continue for ten days on the Government grounds back of Machinery Hall.

THE Centennial Executive Committee have under consideration a series of international Congresses for the discussion of the following subjects:

1. A uniform system of statistical inquiries, reports, and summaries, and their interchange.
2. General system or plan of international exchange of copies of works of art, antiquities, and publications.
3. A uniform system of weights, measures, and coins.
4. Protection of property in inventions; international patent laws.
5. International copyright.
6. Meteorological observations and reports.
7. Astronomical observations and reports.
8. Lighthouse systems, cautionary and danger signals, rules of navigation, etc.
9. Upon a general and uniform system of representing the results of geological surveys upon maps and sections.
10. Natural history nomenclature.
11. Upon a proper system of fishing regulations, and the best methods of multiplying food fishes.
12. Upon the organization and plans of international exhibitions.
13. Medicine and surgery.

AT the suggestion of the Centennial Commission, Mr. George P. Rowell has in contemplation a plan for a large and complete exhibition of American newspapers at Philadelphia. It is proposed to put up a building 66 feet in length and 44 in width, and furnish it with enough cases, containing 150 pigeon-holes each, to hold all the 8000 periodicals published in the United States. A room is to be fitted up to serve as a sort of headquarters for newspaper men attending the exhibition, where they can write and read and transact all their business. The plans for the building have been selected and are now in the hands of an architect. Mr. Rowell has devised a plan for the conduct of the exhibition, and the project will be carried out if the proprietors and publishers of newspapers show a disposition to co-operate in the undertaking. It is certainly desirable that so important a branch of American industry as is represented by the American newspapers should have a proper treatment at the Centennial Exhibition, for our newspapers are thoroughly representative of our people, and illustrate more strongly than any thing else the marked progress we have made in the first century of our national existence. Mr. Rowell's plan seems to be a good one; it will cost from $15,000 to $20,000 to carry it out, and if 200 of the leading newspapers of the country would contribute $100 each, the whole expense could be met.

WHAT may prove a striking and interesting feature of the Centennial celebration is an immense album, containing the autographs of several thousands of the leading men of the country, beginning with the President, Cabinet, Supreme Court, Senate and the House of Representatives, which is to be covered with a glass bell and inclosed in a safe, with a front panel of thick glass, through which the volume may be plainly seen from the outside. It is proposed to put the safe in the rotunda or other conspicuous place in the Capitol, there to stand until the year 1976, an object of curiosity and attraction and a souvenir to everybody for the next hundred years. The autograph album will be accompanied by the inkstand and pens with which the names were written, and, if possible, by another album containing, as far as they can be obtained, photographs of the signers. The President, Cabinet, and Supreme Court have already written their names, and the work is progressing quite satisfactorily.

THE Centennial Fire Department is about to be organized. It will have three fire stations. Twelve or fifteen engines, presented by various manufacturers, will soon reach Philadelphia. The Fire Department will be able to make a respectable show in itself, and will doubtless give a good account of itself if its services should be required.

THE buildings of the Brewers' National Association are to be erected north of Agricultural Hall.

NEW-HAMPSHIRE'S State building will be 30 by 40 feet, two stories high, with two projecting and spacious piazzas on three sides. The location is one of the best and commands a fine view of the grounds. The committee are short of funds, and it is proposed to appeal to the citizens of New-Hampshire to contribute toward the erection of the building, and in making a creditable exhibition of the various industries of the State.

CONCESSION has been granted to Mr. Charles Calmann, of this city, for the erection of a Hebrew restaurant on the Centennial grounds, to accommodate all Israelites who will visit the Exposition, and who will observe the dietary laws of their religion.

A NATIONAL effort is being made by the colored people of this country to erect a monument in Fairmount Park, Philadelphia, and unveil the same on the Fourth of July, in the presence of representatives of every civilized land in the world, in honor of the emancipation of the colored race.

PROFESSOR WARD, a taxidermist of Rochester, New-York, has made application for space to set up skeletons of the different animals of former ages.

MR. J. G. GERDING will exhibit at the Centennial, under the auspices of the South Pacific Railroad Company, 420 varieties of Mexican woods, in addition to other woods of the Pacific coast.

THE statement that the Great Eastern is being refitted to run between Liverpool and Philadelphia during the Centennial is officially denied. The steamer is in dry-dock for necessary repairs, and her owners have no intention of leasing her for transatlantic service.

BY the returns made to the State Superintendent of Education, there will be on exhibition in the Centennial Buildings, on behalf of the New-Jersey schools, 1000 specimens of artistic drawing and 1500 of map drawing, 1000 mathematical operations, 800 of analysis and parsing, 600 compositions, 1200 specimens of writing, 1500 spelling presentations, 1200 specimens of primary work, 600 of miscellaneous work, representing the individual labors of 25,000 pupils.

IT is promised that the British Colonies will be more fully represented than at any previous international gathering. The exhibits from Australia, New-Zealand, and the Cape of Good Hope are already on the way. Canada will be a large exhibitor, thanks to the energy and intelligence of her numerous and influential Commission. It is predicted that those accustomed to judge of Canada solely from the standpoint of her agricultural, mineral, timber, and fur resources will be surprised to find how rapid is the progress she has made as a manufacturing country.

QUEEN VICTORIA has placed the following pictures at the disposal of the Centennial Commission: "The Marriage of the Young Princess," by Northcote; "The Marriage of H. R. H. the Prince of Wales," by Frith, both from Buckingham Palace; "The Meeting of the Members of the Royal Academy," Zoffany, an engraving, from Windsor Castle; Hayter's portrait of "Her Majesty in Coronation Palace," and Benjamin West's "Death of Wolf," from Hampton Court Palace. The Royal Academy will send diploma paintings and busts by a large number of deceased members. South Kensington Museum will contribute an interesting and instructive collection, together with a history of the rise of art industry in England.

IN the Australian Department, a large pyramid of tin will be exhibited, twice the size of that which recently attracted so much attention in the school of art exhibitions in that country. Over three hundred specimens of Queensland timber will also be on exhibition. Mr. Mackay, the Commissioner from Queensland, will arrive about April 10th.

THE Canadian Centennial Commission concluded its labors January 29th. The United States Commissioners have consented to grant additional space for the display of Canadian lumber, as requested by the Lumberers' Association. Room will now be allowed for 10,000 feet of each kind of lumber.

NAPLES will send a large quantity of coral and other goods.

BARON DE SANT' ANNA, the Portuguese Minister at Washington, has been nominated Centennial Commissioner.

THE Indian Court will occupy a prominent place in the Main Building. In all previous international exhibitions the section for the display of the British Empire has been rather a collection of curiosities than an industrial display. At Philadelphia it is proposed rather to exemplify the resources of the Indian Empire by an exposition of its agricultural and mineral products, and a complete representation of the various industries for which India is renowned. Nevertheless there will be an interesting and valuable selection of curiosities, including some of great historical interest, which have never been shown at other exhibitions. Dr. Forbes Watson, the well-known authority on Indian products and industries, will superintend the preliminary arrangement of this department of the British exhibit.

SWITZERLAND will show collective exhibits from the Cantons of Appenzell, Basel, Freyburg, Geneva, Luzerne, Zurich, Berne, and Neufchatel. In the educational department there will be exhibited 11 kindergartens, 14 polytechnic schools, and 7 deaf and dumb and other institutions. Of philosophical and other scientific instruments, there will be 58 firms exhibiting, and 41 will show watches and parts of watches, an industry for which Switzerland is celebrated; 7 will exhibit musical works. In the department of engineers and architecture there will be 27 exhibits sent by Cantonal governments and railroad companies. Of models and plans of public buildings, halls, railroad stations, hotels, etc., there will be 37 exhibitors. Models and plans of working of beneficial associations will be exhibited as follows: For educating the poor, 10; orphan asylums, 7; reformatory homes, 9; other institutions, 8. In the department of arts there will be 15 exhibits of sculpture and fine wood-carvings; paintings, 1; etchings, 7, and photographs, 9. Agricultural productions, 24. Working tools for the manufacture of watches, clocks, etc., 8. In all there will be 277 firms exhibiting. The general government at first appropriated 250,000 francs for the exhibition, but afterwards made a further appropriation of 120,000 francs. Commissioners have been appointed, and will be here about the middle of March. Rudolph Koradi is the resident commissioner. The general exhibit will be placed in the main building, with the exception of photographs, which will be shown in the hall devoted exclusively to their use. Neither agriculture nor horticulture will be represented by the bleak and barren little republic, nor will any machinery be sent. The goods, including the cases in which they are to be exhibited, have all been prepared at Winterthur, in the Canton of Zurich, and when received here next month will be immediately placed in position. Laces for wear and curtains of the same fleecy material from Appenzell and St. Gall will be prominent among the articles exhibited. No silk ribbons will be shown, the manufacturers of Basle having declined to send any of their goods. This is because the American domestic ribbons have almost completely destroyed their trade in this country, which at one time was their best market. Some of our own merchants, however, have purchased large quantities of the best Swiss ribbons, which they will exhibit in comparison with home manufactured goods.

THE Chinese Government has named Mr. E. B. Drew and Mr. G. Detring, Commissioners of Customs in that country (who were on the China Commission at Vienna), to purchase a large collection of bronzes, lacquer, silks, crapes, embroideries, carvings in ivory, sandalwood, etc., porcelain, cloisonné, and other objects illustrative of the marvellous skill and quaint taste of this most patient of the human family, and they will be forwarded to Philadelphia for exhibition, and in great part for sale there. The gentleman named to represent China at the Exhibition, as her Commissioner in charge of this collection, is Mr. J. L. Hammond, originally of Salem, Mass., but for many years past a Commissioner in the Chinese Customs. It is not impossible that one or two other gentlemen will be appointed colleagues of Mr. Hammond. Possibly some intelligent Chinese will be sent over to report to their countrymen what they learn about exhibitions. All the room apportioned to China will be well occupied.

[Cleveland Herald.]

THE "DYNAGRAPH."

IT is now some forty-five years since the railroad are fairly commenced in this country, and on many points connected with railroad resistances we are yet groping in the dark from the want of formulæ deduced from practical experiments. Mr. P. H. Dudley, recently chief-engineer on the Valley Road, and a gentleman who has devoted much study to matters of railroad economy during the past year, has brought into service a most valuable invention, known as the "Dynagraph." The object of the machine is to ascertain the resistances of engines, cars of different construction, and railway-trains at all rates of speed upon the straight and curved portions of the track. Comparatively few experiments have been made in this country to ascertain the power absorbed in friction of the engines, cars, and trains in use. We have depended largely for information upon English and French experiments. Such information, to a great extent, must necessarily be unsatisfactory, for the good reason that the construction of the entire system of railways in those countries is materially different from our own. The conclusions to be drawn from the experiments of scientific engineers in Europe are not applicable to our roads.

It forms a large part of the expense of a railway to operate the motive power which is used to overcome the resistance due to heavy grades, sharp curvature, excessive weight of cars, different sized wheels and journals, kinds of brass and lubricants, condition of tracks, etc. The amount of force an engine exerts, for instance, in drawing a train is much less than is generally supposed, ranging, under ordinary circumstances, from 4000 to 5000 pounds. It is, therefore, quite obvious that it is important to reduce the resistance due to various causes to the lowest possible limit, with a reasonable cost of construction, the benefits of so doing not only accruing to the railway companies, but to the entire community, as thereby the cost of transportation may be cheapened.

Mr. Dudley has privately, and in a limited way, been operating with the "Dynagraph" for a month or two past, and the results have been such as to warrant the Lake Shore and Michigan Southern Railroad Company in offering him facilities to apply the most thorough tests of its practicability and utility. On Tuesday afternoon, January 18th, a train of forty-seven cars, with a caboose, in which the machine was operated, made the run from the Union Depot to Collinwood. The estimated weight of these cars, with their burden of freight, was about 948 tons. The cars comprised thirty-one of the White Line, fourteen of the Merchants' Dispatch, and two of the Empire Line. They were drawn by the locomotive "Jefferson," with six wheels connected; weight of drivers, 49,000 pounds; cylinders, 16x22; and the steam carried, 120 pressure. The portion of the road traversed was well adapted for a fair trial, being part of the way a thirteen-foot grade, having several curves and a number of undulations, thus testing the capabilities of the machine in different ways. The train was a heavy one, and consisted of rather more loaded cars than it is expedient generally to attach to even as powerful a locomotive as the one employed. The speed at starting was at the rate of from three to four miles per hour, and increased to some ten or twelve miles per hour when over the heavy grade. It was gratifying to note the accuracy with which the machine indicated the rate of speed, the curves made, the power employed, and the oscillation of the cars. The engine, on the grade before mentioned, pulled 14,200 pounds, and where the resistance was less but a few hundred.

The construction of the Dynagraph is as follows: Underneath the car is a steel cylinder, four inches internal diameter, filled with oil, in which a piston is fitted. The drawhead of the car is attached and draws on the piston, which forces the oil in the cylinder through a pipe to a small cylinder, in which is fitted a piston acting against springs of known tension. The crosshead of the small piston moves the levers which carry the pencil to mark on the paper the amount of force exerted. The paper used is what is known by engineers as continuous profile paper plate B, and is wound in lengths of 150 feet upon a drum, upon one side of the instrument, and passes through between two steel rollers over a little table about one foot square, through another set of steel rollers, then on to another drum, which winds up the paper as it passes through the rollers. The paper is moved by the steel rollers from direct motion of the car-axle, each one quarter of an inch of the paper representing one hundred feet upon the track. By a brush wheel, compensation can also be made for any increase or decrease of distance upon curves when found necessary—an armature carrying a pencil making a straight mark, except at the end of seven and one half seconds: the magnetic circuit is closed by a clock and the armature drawn back, indicating the distance traveled in the time mentioned. Consequently the speed for any given instant can be calculated, as it is necessary data in the case under consideration.

The instrument had to be constructed very strong to withstand the excessive shock due to unavoidable concussions in operating trains, yet at the same time made so that its adjustments are delicate. It was built by A. J. Johnson, one of Cleveland's mechanics, who not only designed many of the details, but carried them all out with great fidelity, and to whose excellent workmanship the success of the Dynagraph is largely due.

INDIANA STATE BUILDING AT THE CENTENNIAL.

HEREWITH we present elevation and plan of the Indiana Centennial Building, soon to be erected in Fairmount Park. The intention is, says the *Graphic*, to make the Indiana building as far as possible characteristic of Indiana homes and productions. It will be constructed of a combination of wood and other building materials, a frame of wood being the support of the building and roof, to which an outer wall of brick, stone, terra-cotta, iron, and coal can be attached. There will be three entrances by four broad steps to the front and side porches, and an open-roofed balcony will extend from each side entrance to the front entrance. The assembly hall is designed to be a grand auditorium for miscellaneous gatherings. It will be in the form of an irregular cross, 55 feet at its longest angle, and will have about 1400 feet of floor. From the level of the ceilings of the side rooms it is spanned by a truss-arched roof at a height of 24 feet above the centre of the hall. It will be lighted by the rotunda above, and an ornamental fountain will play in the centre below. On the walls will be 200 tablets, of which number 92 will be used by the counties of the State for the general statistics of each county, and the remainder will be given to individuals or firms. There will also be committee-rooms, a ladies' parlor, invalids' room, post-office, telegraph-office, baggage-room, gentlemen's parlor, and the building will be a place where any citizen of the State can be at home, to entertain friends and dispatch business. The whole will be surmounted by a handsome truss roof, from the top of whose arches a lighted open rotunda of glass and wood will rise, crested with metallic ornaments and statues. The entire cost of the building will not exceed $10,000.

GREAT BRITAIN AT THE EXHIBITION.

FROM an official review of the promised exhibits from Great Britain, published in the London *Times*, it appears that the leading firms in the various departments of British industry will be fully represented, so that the collection will fairly exhibit the range and character of the manufactures of that country.

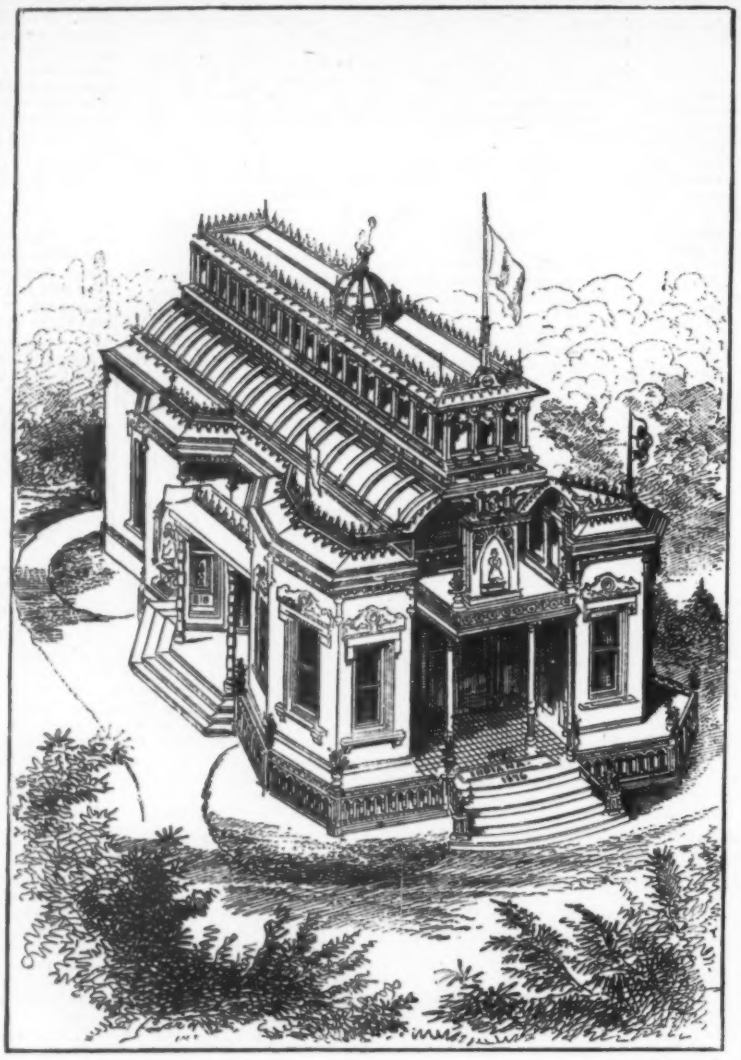
Despite the report that the great carpet manufacturers had decided not to be represented, carpets will show a number of names equal to, if not surpassing, those of any previous exhibition.

The leading silk manufacturers will contribute, and of woollens a full quota is promised. The art of printing, paper-making, and kindred industries, will command a unique collection. In optical and scientific instruments, few names of any note will be found wanting. Musical instruments are fairly and clocks and watches well represented. Clothing in its various departments will be displayed by leading houses. Fire-arms will almost catalogue the principal makers, and will form one of the principal features of the British section. Furniture for both household and church purposes will be sent by a large number of the most noted houses. In linens, the leading manufacturers of both Scotland and Ireland will be represented. A magnificent display of china-ware is promised. The department of art metal-work will be richly and copiously represented by the products of a large number of noted manufacturers. In Machinery Hall a full representative display of the various classes of machinery may be looked for. There will be a large and comprehensive gathering of textile machines, including branches never before displayed at exhibitions of the sort.

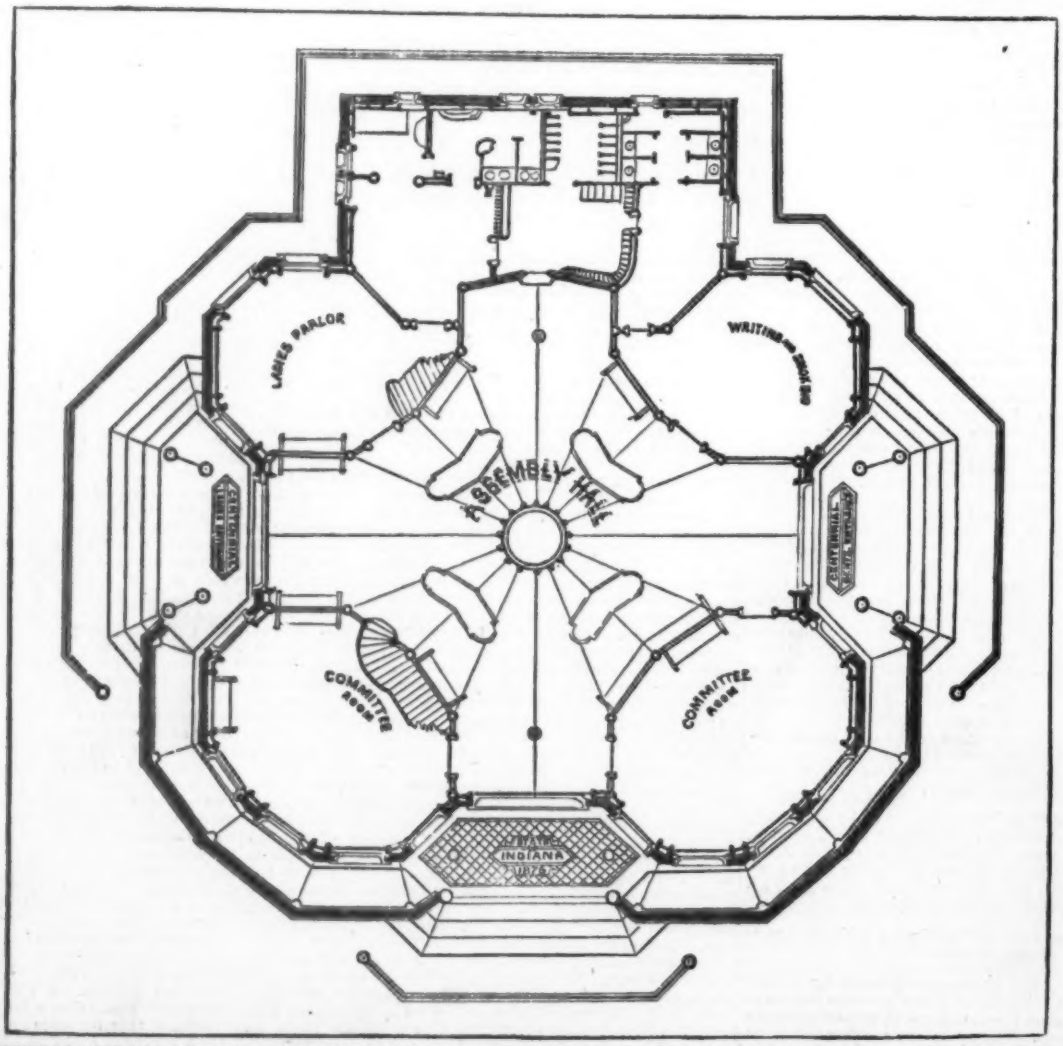
Printing-presses will be represented. The large collection of stone-dressing machinery will contain some novel features. The various processes of sugar-making and confectionery will be fully exemplified. In machine tools the British manufacturers hope to "hold their own in quality, ingenuity, and workmanship even against their Pennsylvania rivals." Several sewing-machines will be sent to compete with those of the original inventors. The collection of engineering models, both railway and miscellaneous, is very complete; and a large collection of fuel-economizers will be presented.

The official list of exhibitors, printed by the Philadelphia *Press* in seven columns, fine type, shows that the richness of the British exhibit has not been over-estimated.

PROFESSOR BALESTRIERI, of Naples, has recently proposed an apparatus composed of several discs of polished silver or copper, so arranged as to transmit successfully the light received, so that all the rays falling upon the discs are concentrated into one powerful beam. The invention resembles the system of Fresnel, but the latter utilizes only about one one third the light received, while M. Balestrieri's device, it is said, utilizes the greater portion. With an oil-lamp having a burner 2·7 in. in diameter, at a test of the above described apparatus, a beam of light was transmitted, which enabled a newspaper printed in ordinary type to be read at the distance of 0·6 of a mile.



THE INTERNATIONAL EXHIBITION OF 1876.—ELEVATION OF THE INDIANA STATE BUILDING.



THE INTERNATIONAL EXHIBITION OF 1876.—PLAN OF THE INDIANA STATE BUILDING

LESSONS IN MECHANICAL DRAWING.

By PROF. C. W. MACCORD, Stevens Institute.

(Continued from p. 116.)

LESSON V.

WE have assumed that all these exercises are to be drawn in ink, but it is not at all to be understood that this is necessary. We hope they will be, and do not hesitate to recommend all to acquire a mastery of the pen, for the reason that drawings so made are much more satisfactory, not only to those who see them, but to those who make them. But still a very pleasing effect can be produced by the use of the pencil; it may be proper then to remind those who do not wish to ink their drawings, that all the "construction lines" must be made with the lightest of touches, and it is well to erase as completely as possible such of them as it may not be desirable to retain, before retouching the outlines. This may result in the partial obliteration of lines which we do wish to retain, but so long as the faintest trace of them remains, that is sufficient to answer the purpose, and by attending to this precaution these lines may be then drawn in firmly, and their sharpness of definition will not be destroyed by the subsequent use of the rubber, which will certainly happen if they be drawn heavily first, and the construction lines rubbed out afterward.

It may be added, that the size of the drawings is immaterial; the principles of their construction and the manipulation of the instruments remain the same, however the scale is varied. We have given a convenient size for execution, with triangles of the dimensions originally given in Figs. 1 and 2, but that is not to be taken as a hint that it must be rigidly adhered to. Still, it will be found that in beginning the practice of line-shading, small surfaces will be less difficult than large ones, and it will therefore be better at first not to attempt materially to increase the sizes of the figures as they are given.

In the preceding lesson, we described a process of making a sort of skeleton groundwork upon which various designs were to be mapped out, by dividing the sides of a square into equal parts, and cutting up the square into smaller ones by joining the points of division. In the examples which we gave, the large square was divided into nine or into sixteen small ones. It will naturally suggest itself to the reader, that this process may be extended almost indefinitely; and he will find it an interesting and profitable exercise of his ingenuity to design for himself new combinations of a similar nature, which he will probably be able to do without our pursuing this method much farther, and we accordingly leave him to do so, after giving a few additional figures, for the construction of which the square is cut into twenty-five small ones, each side being divided, by the process shown in Fig. 33, into five equal parts, as shown in Figs. 52–55; in the last two, the sides are also bisected. In Fig. 53, the parallel lines joining the points of division are drawn at angles of 45° with the sides of the square, so that the transverse lines are omitted as unnecessary; in the others, these last, as well as all other requisite construction lines, are dotted in, as they were in the preceding examples, and further explanation would be superfluous to any one who has carefully followed what has heretofore been said.

In Fig. 56, we have a square of which three sides are divided into five parts as before; from the extremities of the fourth side, lines are drawn to each of the points of division. This gives an exercise of a very different character, in which the element of form is wholly lacking; but simple as the construction is, it will be found that the production of a pleasing effect is not as easy as it may seem. The difficulty lies in the fact that a considerable number of lines converge in a single point; this circumstance renders great care necessary both in pencilling and in inking, for a very slight error in the direction of any one of the lines will make it appear as if it overlapped its neighbor, as in fact it would do, but ought not to do; and this defect in the execution, it must be impressed on the mind of the student, is one that is very apparent to the eye, even when the error is in itself very minute. Were there only two or three lines, with the angles between them comparatively large, this would not be the case, at least to so great a degree. Again, all lines on paper, whether in pencil or in ink, have some thickness; and much care is necessary to avoid producing a blot or a mass of shade, while the effect should be that of a pencil of rays of light, radiating from an absolute point. We therefore point out to the student, that he must not attempt to draw all his lines absolutely to the point: the sides of the square should, of course, meet each other; but an allowance must be made for the thickness of the mark in drawing the other lines, each of which should terminate as soon as it comes in contact with the next one, which, by reason of that thickness, will be a little before it reaches the point of convergence. Precisely how much before, will depend on the absolute thickness of the line itself as drawn, as well as on the acuteness of the angle between it and the adjacent one: no positive rule can therefore be laid down, and the tyro must learn this by experience. In drawing with ink, the lines marked *a*, *b*, *c*, etc., should be drawn in their order, the ruler always being, as described in the first lesson, held below the line, which is to be drawn by its upper edge; and each line must be allowed to become thoroughly dry before the next one is drawn, as otherwise a blot will be almost certain to result from the flowing together of two or more lines.

For drawing the radiants from the other corner of the square, the paper may be turned round, in order that they may be drawn in a similar order: it is important to remember that the lines should always be drawn *from*, not towards, the point of convergence in such a case as this, which, by the way, is one of frequent occurrence; and any change in the position of the paper or of the operator, which facilitates the execution of any part of the work, is always admissible in drawing mechanically. Before attempting to make a finished drawing of this, should the reader be desirous of making and preserving a series of copies of the illustrations we give, it will be well to make several preliminary trials, by merely drawing, in the manner explained, any number of lines radiating from a point, as in Fig. 57, without going to the trouble of dividing the square, which is not at all necessary to the practice of this exercise; we have done it in this case merely for the sake of making the outline of the diagram uniform with the series preceding: as having given twenty figures, including this one, of which the first step is the drawing and subdivision of a square, it may be found satisfactory to those who are interested in such work to make a sheet of drawings in which these are arranged in four rows, of five each, thus forming a symmetrical group of exercises.

We strongly recommend this to be done; it will give practice in a particular not yet mentioned, but of great importance; we mean in regard to giving an effect of uniformity to a collection of isolated figures. If these be drawn singly, each may be good in itself, and yet when placed side by side the effect may be unpleasant: some may be drawn with heavier lines than others, or of different sizes from others—and it is one of the accomplishments of a perfect draughtsman to be able to *arrange* the figures well upon his sheet, and to secure harmony, if not absolute uniformity, in the appearance of the whole. This accomplishment can be acquired only by practice; but we may give a hint or two which will be useful to those who will heed them. In the case before us, the *arrangement*, evidently, is a simple matter, as, if the squares be made of uniform size, they will naturally dispose themselves, as we mentioned just now, in four horizontal rows, with five in each, and as evidently the spaces between those in each row should be equal, as well as the spaces between the rows; though it is not necessary that the latter spaces should be equal to the former.

Fig. 52.

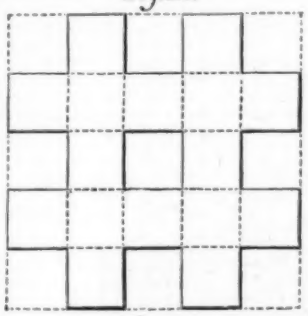


Fig. 53.

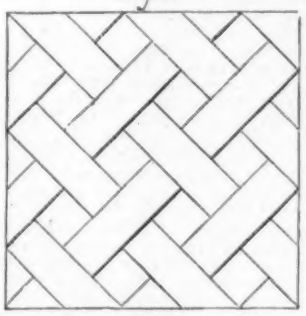


Fig. 54.

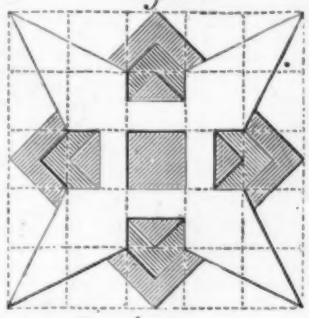


Fig. 55.

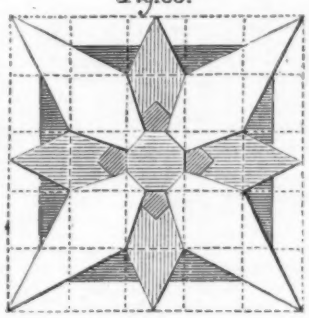


Fig. 56.

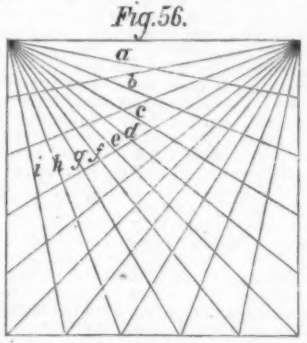


Fig. 57.

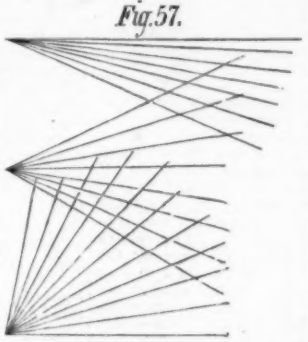
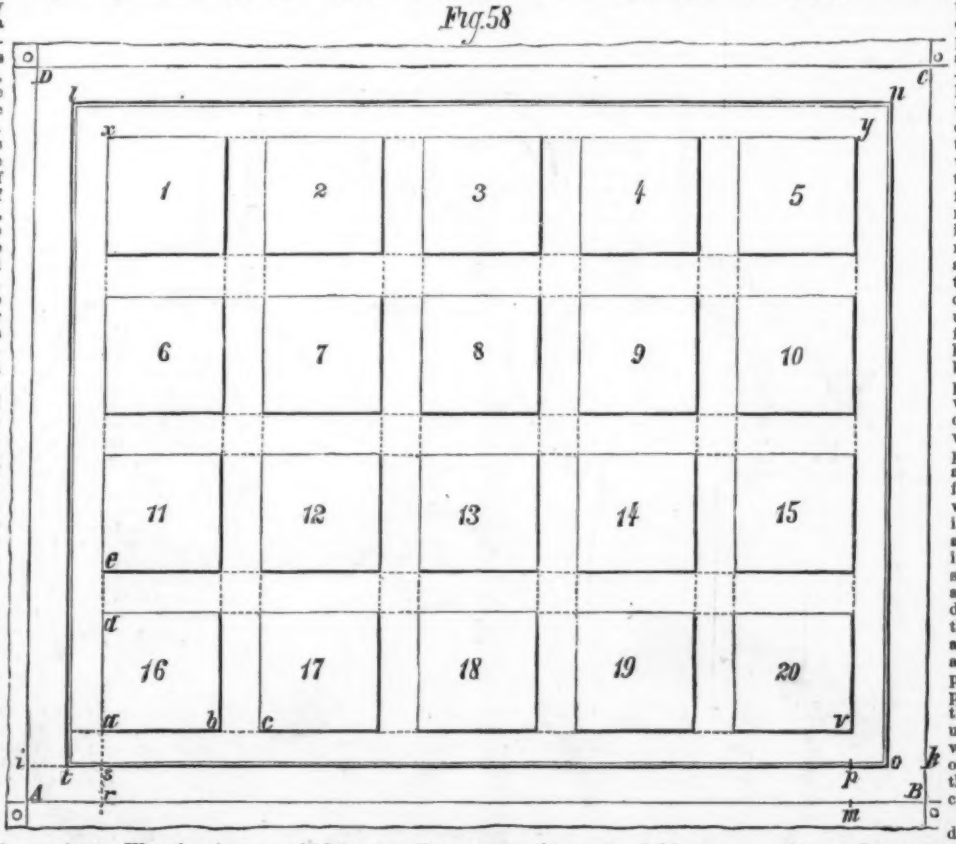


Fig. 58



Now, supposing the diagrams to have been arranged and lightly pencilled in, uniformity in the finished lines, whether in pencil or ink, will be best secured by a systematic procedure, and time will also be saved by it. Some, anxious to see how one particular figure will look, will complete that one by itself, and then go on to finish others one by one. This is a dangerous operation for any but an experienced draughtsman, as it is not the easiest thing in the world to make sure that all the outlines shall be of the same strength, if drawn by instalments in this way, and at the best it is clear that time is lost by changing from fine to heavy lines and back again so many times. It is on all accounts better to set the pen once for all, so as to draw the lines of the strength selected for the full outlines, and to draw these in all the diagrams or figures at one continuous operation: then make all the dotted lines on the whole sheet, by which the operator will be much more likely to secure uniformity of style in them throughout.

The superfluous pencil lines being now erased, the line-shading, if there be any, should next be done: here, it is to be noted, the shading of each figure had better be completed before any part of another is touched, as in this respect uniformity in the tone of similar parts of one figure is of more importance than an absolute correspondence of parts of different figures.

Should the paper be in the least soiled by dust, etc., at the completion of the shading, it should be carefully cleaned, and the shadow-lines drawn, as before insisted on, at the very last.

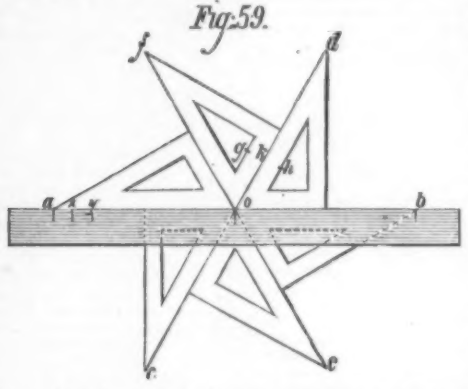
We may here remark, that care should be taken to keep the paper and the instruments free from dust while drawing. The triangles and rulers are very apt to have dust adhering to them, and if there be any, either there or on the surface of the paper, it is rubbed into it by the constant sliding of these instruments over it. In order to prevent this as much as possible, there should be always at hand a clean soft piece of cloth—an old, well-worn, fine linen handkerchief is the best—with which the instruments should be carefully wiped before beginning to draw, and from time to time while the work is in progress; the paper also should be as carefully brushed with it, but without rubbing at all. We have already insisted that the paper should be rubbed as little as possible with any thing; and we may here say that for cleaning a sheet which is dusty, bread is the best thing to use. It should not be perfectly fresh, nor yet stale enough to be hard; a piece of the crumb being broken out is to be rubbed on the paper with the open palm, by which it will be rolled out into countless homœopathic pills, which, being pressed into the pores of the paper, will pick up and remove the particles of dust far more perfectly than the rubber would; and, moreover, they seem in some way to polish the surface, and enhance the brilliancy of the ink-lines. We may add, that the same process may be used to great advantage in cleaning brushed drawings and engravings; but as the bread removes pencil-marks also to some extent, it can not be applied to drawings finished in pencil without injuring the appearance of the lines; although if these be retouched afterward, the use of the bread may be advisable when much dust has accumulated on the sheet. But we again insist that prevention is better than cure in this as in other things.

Having recommended the student to make a drawing of the group of twenty figures, we can not do better than to give him some directions as to how to set about it; for even in the arrangement of the isolated figures upon a sheet, the advantage of some system will soon become evident, and many fall into a habit of carelessness in this respect, under a mistaken idea that if the single drawings are well executed, the other is of no consequence. Of minor consequence, perhaps, it may be; but there is no reason why it should be so utterly disregarded as it too often is.

We accordingly give, in Fig. 58, an illustration of the mode of laying out a sheet for the purpose named, the squares for the designs being numbered from 1 to 20. We may say, that although these designs may be executed, as we have stated, with the triangles alone, a simple ruler, say fifteen inches or

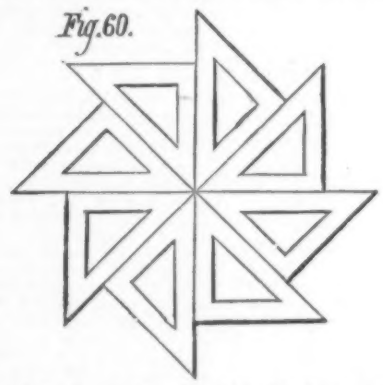
more in length, is very desirable for drawing long lines, and we shall assume that the operater has one at hand. Having determined the side of the square *a b* and the space *b c* between the vertical rows, it is clear that as we have five rows and four spaces, the whole length *a v* will be four times *a c*, *plus a b*; and if the spaces be marked off on a long strip of paper, the line *a v* may at once be drawn of the exact length. Now, draw at *a* a line perpendicular to *a v*, and set off on it *a x*, equal to four times *a b*, or *a d*, plus three times the space *d e*, between the horizontal rows; and at *v*, draw another perpendicular to *a v*, equal to *a x*, and draw *x y*. This completes a rectangle *a v y x*, on the sides of which the corners of the outer rows of squares are to be marked, and by drawing very lightly in pencil the transverse lines through

Fig. 59.



these points, the whole of the twenty squares will be determined by their intersections, much more rapidly and accurately than if they had been laid out one by one. While the ruler is in position for drawing *a x*, set off *a s*, the space between the outer edge of the diagrams and the border, if one is desired, and also beyond that, *s r*, the breadth of the margin; and in a similar way, while drawing *v y*, set off the corresponding distances *v p*, *p m*; the same operations, it is hardly necessary to add, being repeated at the upper side of the sheet. Then, when the ruler is set for drawing the border line through *s* and *p*, lay off *p o* and *s t* equal to *a s*; *l* and *n* are marked in precisely the same way, the object being to draw the lines of the border of the exact length, without overrunning the intersections even in pencil. If a double line, like that shown, be desired for the border, the space between the outer and inner one may either be determined by the eye, or laid off in a similar manner. The breadth of

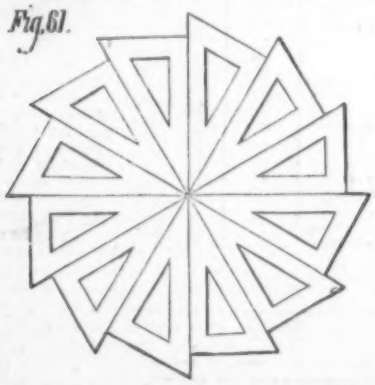
Fig. 60.



the margin is also set off at *o k* and *t i* while drawing the line *e f*, and the same being done above, the outer lines may be drawn through the points thus determined, clear across the paper, since that is finally to be trimmed off by these lines, and it therefore makes no difference whether they be terminated at the intersections or not.

It will be remarked that we give our instructions on the assumption that the work is to be done in ink. This is because we wish to cover the whole ground; we hope that none of our readers who draw at all will rest content until they can execute their drawings in a style that will make them worth preserving, nor until they are masters of the means of making them durable. But it is always to be kept in mind, that in the main the same instructions apply to the use of the pencil on either slate or paper; and we do not wish any to draw the false inference that because we advise all to draw

Fig. 61.



in ink, the line of practice which we suggest, the subjects selected as examples and exercises, or the hints given for their most satisfactory execution, are at all dependent on their doing so for whatever benefit may be derived from them. And so in regard to this drawing of the connected group of diagrams—it seems in a sense to go beyond the range of what can readily be done with the instruments at first named; still it is possible to make it without any thing else, though, as we have before stated, all these exercises, singly or in groups, can be executed with greater facility by the aid of other appliances. We do not wish then to convey the idea that it is absolutely essential to make such a sheet as the one spoken of, but to aid as far as possible those who will act on our advice to do it, in doing it in the best and readiest way.

As additional exercises in the drawing of radiants, acute intersections, and shadow lines, we give in Figs. 59, 60, and 61, three different groupings of framed triangles, of which the constructions are obvious on inspection; it may, however, be suggested, that the radiating lines should be first drawn, and their lengths set off. Thus, in Fig. 59, having determined on the length *a o* of the hypothenuse, or longest side of the triangle, double it, and mark the points *a*, *o*, *b*, on the paper slip, as shown, and by its aid transfer them to the line *a b* of the drawing; with the 60° triangle draw *c d*, *e f*, and mark their lengths in the same way, and draw parallels to these lines from the points *a*, *c*, *e*, etc., to determine the external outlines of the triangles. Set off *a y* equal to twice the selected breadth of the frame, and bisect it at *x* as before described. By placing the point *x* on the line *o d*, at *k*, for instance, with the edge of the paper perpendicular to that line, the points *a y* may at once be marked off at *g h* more quickly and with less liability of error than if the single breadth *a x* be set off twice, by shifting the paper scale, and the same method is to be pursued in drawing the other figures.

(To be continued.)

THE BOOMERANG IN AFRICA.

WHEN the boomerang was first discovered among the aborigines of Australia, its possession by a people so low in the scale of intelligence was held to be a greater marvel than the thing itself. Those scarcely human savages were plainly incompetent to invent a weapon so uniquely ingenious; yet, it was argued, if the secret of its production and use was ever taught them, where were the teachers, and why were there no other lessons conveyed at the same time; and how was it possible that so useful an invention could have gone out of use in the countries whence the Australian received it?

When savage races came to be more widely and closely studied, however, it was found that the boomerang had a wider range than had been accorded it. So far from being peculiar to the Australians, and an evidence of their complete isolation as a race, it became the means of tracing relationships and migrations among the negroid races, to which other clues were all but completely lost.

The distribution of this weapon, in its various forms, has been traced by the English ethnologist, Col. Fox, who shows it to be common to the greater part of the black races of mankind, including the aboriginal (Dravidian) tribes of Central India, and the natives of Central Africa, as well as the vanishing tribes of Australia, with whom it remained almost the sole inheritance from the better days of the race.

AFRICAN BOOMERANGS.

In his *Artes Africanæ*, Sweinfurth gives a number of illustrations of the peculiar iron boomerang of the Niam-Niam—the highest known development of this remarkable projectile. The accompanying illustrations are copied from Sweinfurth's drawings.

Though presenting great diversity in the shape and ornamentation of its parts, the Niam-Niam boomerang consists in every case of three two-edged blades, the longer one placed at right angles to the main shank, of which the handle is simply an elongation usually wound with cord to improve the grip. This wicked-looking weapon is thrown so as to spin like the boomerang in a horizontal plane about its axis, and its three cutting blades are so placed that, no matter what may be the position of the missile when it strikes, it is sure to hit with a sharp edge. It is also used in hand-to-hand contests without throwing.

A similar iron weapon with two blades and a wooden hilt is used by the negroes of the upper Sennaar. The longer blade is sometimes sword or sickle-shaped, sometimes waved like a Malay creese. The lateral blade is short, and serves chiefly as a guard to the hilt when used in cutting and parrying. The iron missiles of Central Soudan are of various shapes, and usually have only two blades. Those of the Fans of Equatorial West Africa closely resemble the Niam-Niam weapon.

Missiles of the boomerang type, sometimes of wood, sometimes of iron, are used over a large part of the northern half of Africa. A wooden variety, first observed by Sir Samuel Baker in Abyssinia, and common among the Mohammedan negro tribes as far west as Lake Tsad, is apparently the original of the whole class. It is a flat, two-edged club, curved more or less like a crescent, and is much used in hunting wild fowl and small animals. Its resemblance to the Australian and Dravidian forms affords a link connecting the arts of all the black races of the Southern Hemisphere—races supposed by Prof. Huxley to represent the remnants of an early race which inhabited the submerged continent of the Indian Ocean. It is worthy of remark in this connection that curved throw-sticks are figured in hunting scenes on the monuments of ancient Egypt, and also in similar scenes depicted on the terra-cotta records of Nineveh. How far the ancient clubs possessed the peculiar property of the Australian boomerang, that of returning on its flight so as to enable the thrower to hit an object round a corner, on the opposite side of a thicket, or behind him, there is no way of telling.

[Deutsche Industrie Zeitung.]

INDIGO SUBSTITUTE.

OF late a coloring matter, known by the name of indigo substitute, has been largely introduced in commercial circles, and it appears to be entitled to an important position in practice, inasmuch as it is well suited to supersede either totally or partially the use of indigo in the dyeing of cotton. The advantages which it possesses are that the colors so produced not only show a high degree of genuineness, and insusceptibility to the action of light or of alkalian or weak acids, but it is also noted for the easy manner in which it may be fixed on the fibre. The substance forms a thick liquid of a blackish color; when diluted and held up to the light, it appears of a beautiful violet color, but if allowed to stand it assumes a pure blue color, no doubt through the absorption of the oxygen of the air. Indigo substitute is easily soluble in water, and may then be precipitated by the use of alkalies; it would appear, however, that this precipitate is not entirely soluble in acids. Weak acids do not affect the substance, but if strong acids are used it becomes reddened and partly destroyed. Applied to cottons, without the use of mordants, it dyes the same easily, but with a dirty violet tinge; if the stuffs to be dyed are first mordanted, then a handsome blue is obtained. For the dyeing of yarns, the latter may be mordanted in a bath of 2¼ kilos. of alum for every 25 kilos. of yarns, after having been passed through the ordinary preliminary manipulations of soaking and washing. The yarns may then be dipped into the indigo substitute (2 to 3·5 kilos. of the latter to 25 kilos. of yarns) and dyed in the requisite shade, after which they may be rinsed in clear water. In chemistry the indigo substitute is much used in the dyeing black of wearing apparels, when the cloth is first dyed blue in the manner just described, and afterwards dyed of an ordinary black color. Woven fabrics may, consequently, be died with the indigo substitute, but it appears to dye wool but very slightly, and silk is dyed into a steel-grey color without mordant. The cost of the indigo substitute in Germany is quoted at 39s. per 100 lbs.

CLEANING WOOL.

THE *Bayrische Industrie und Gewerbezeitung* announces that E. Lix, of Bischweiler, has, after many futile attempts, at last succeeded in discovering a chemical process for the cleansing of animal wool, by means of which the most satisfactory results have been obtained. The process may be applied to wool mixed up with thistles or other vegetable impurities, or to fulled or non-fulled cloths, and the advantage claimed for this process is that the vegetable substances are effectually and cheaply destroyed, without in any way affecting the strength of the cloth or of the wool. The process offers no obstacle to the ordinary dyeing and finishing methods, inasmuch as stuffs or wool so treated are quite as easily dyed and finished as if they had been worked in the ordinary way. Mr. Lix's process is thus described. The stuffs or wools to be cleansed are first dipped into a bath of 3° to 6° sulphuric acid, to which a certain quantity of alum, salt, and borax are added, according to the description of the cloths; as a general rule, the proportion will be to add to every 100 litres of diluted acid about ¼ litre alum, ¼ kilo of salt, and 50 grms. borax. The stuffs may be coiled or turned in this bath during 1 to 2 hours, after which they may be placed in the hydro-extractors, and afterwards introduced to a temperature of 100° to 120° C. For extract the acid is now one of the chief manipulations, and should be carefully and thoroughly done, otherwise the forementioned process would prove injurious to the durability of the fabric. The thorough extraction of the acid is done as follows: The fabric is first washed for 1½ hour in clean water, then treated with Fuller's earth, soda, and lime for a further 2 hours, and finished by washing the fabric another 2 hours in clean water. Sulphuric acid may, however, only be used with white or indigo-dyed fabrics; therefore, in order to render the process applicable to all other dyed goods, Mr. Lix used in such cases chloride of zinc and chloride of manganese, diluted to 6°, in place of the sulphuric acid, and the process may then be continued and finished as heretofore described.

HERACLINE.

ACCORDING to *La Houille*, experiments have been made with this new explosive in pits belonging to the Montrambert Company near St. Etienne (Loire). They go to prove that heracline gives better results than powder with half the charge. Being slower in combustion, and its effects less sudden, the blocks of coal, etc., are better split and less disturbed, the effect-work in proportion to the explosion being greater. The flame being projected to a less distance than with gunpowder, work in fiery mines is rather less risky. The vapors produced by its combustion are innocuous. Its action in respect to hard coal is reported as being particularly satisfactory, the explosion, owing to its slowness, opening any fissure that may permeate the standing coal, and facilitating the work of the pick.

BLEACHING OF WOOL.

COLD water, containing one part of liquid of bisulphite of soda to nine parts of water, the activity of which may be increased by the addition of 1–10 part of muriatic acid. The vessel employed is that used for dyeing cloth in the piece.

IMITATION LEATHER.

COTTON or factory waste is reduced to the condition of wadding, placed upon polished zinc plates of the size of the leather required, and covered with a concentrated decoction of the *fucus crispus*, or any other mucilaginous fucus or lichen. The zinc plates should be kept hot, in order that the imitation leather may dry quickly, and the surface of the plate produces a grain resembling that of leather. The sheet thus formed is passed through hot cylinders, which press and felt the cotton together with considerable force, and render the sheet of uniform thickness. After leaving the cylinders the sheets are treated with boiled linseed oil, dried by heat, then dressed with a thin coating of vegetable wax, and, finally, rendered supple by being passed through channelled rollers. This imitation leather is used for furniture, cap-making, military equipments, shoemaking, and for the sheaths of spindles in spinning-mills.

CHEMICAL RETTING OF FLAX, HEMP, ETC.

By MM. CEYLITS-LATOUR, KINDER, and HOUPIART-DUPRE.

FOR the retting, the water employed is raised by the addition of sulphuric acid to 10 deg.; it is then brought to the boiling point, when the fibres, either green or dry, are immersed in the water, and kept boiling for half an hour; the fibres are then taken out and allowed to drain before being submitted to the second operation.

The disaggregation of the fibre is effected by the addition of the powder already referred to, which consists of equal proportions of quick-lime and English soda at 88 to 90 deg. in hot water, so that the mixture when cold shall mark 5 to 10 deg., according to the nature of the fibres to be treated. When the mixture has been boiled for about fifteen minutes it is allowed to settle, and the clear lye poured off, with which the fibres are placed, after the retting or other similar operations, and are kept boiling for thirty to sixty minutes, according to the matters employed. China grass and other similar fibres may be treated cold with this powder, but in that case they must be left to macerate in the lye for twelve hours, with the addition of one per cent of red tartar. To bleach the fibres afterwards, the water is pressed out and the fibres washed in running water, or steeped in hot water, acidulated to one degree with muriatic acid, then taken out, rinsed, and dried. Lustre is given by means of oyster-shells heated to redness, pounded, finely sifted, and washed through a sieve, one per cent of this powder being added to the lye already mentioned.

DISACIDIFYING OF WOOL, ETC.

By M. SVITAINE, of Verviers.

A PERFORATED tube is fixed in such a manner to the end of the arbor of the machine as to introduce, under a certain pressure, a stream of water from the centre to the circumference of the machine, through its entire height. Another application is the introduction of a stream of hot air from a ventilator through the same pipes, in order completely to dry the wool, etc., which has been disacidified and wrung.

HAI-THAO FOR DRESSING COTTON TISSUES.

A COMMUNICATION was made some time since to the Industrial Society of Rouen, by MM. Houzeau and Clouet respecting the Haï-Thao of Cochin-China, obtained from a seaweed much resembling Iceland moss. M. Payen says that it may be derived either from the *Gehelium corneum*, a seaweed of Java, or from the *Phearia lichenoides*, peculiar to Mauritius.

When Haï-Thao is treated with hot acetic acid, afterwards with water, and finally with ammonia, a residuum is obtained, which, dissolved in boiling water, furnishes, on cooling, a jelly, which is dried and sold as seen. This substance is composed of carbon, oxygen, and hydrogen, and was first imported as alimentary. When placed in water it takes up about five hundred times its own weight of the fluid. It is only soluble in boiling water, and insoluble in weak or diluted acids, alkaline solutions and ether, but is attacked by sulphuric and other concentrated acids.

Haï-Thao is used in France in several industries, especially in preparing goldbeaters' skin, for which the manufacturers were formerly entirely dependent on England.

This substance is also used either to render tissues impermeable, or merely to give them consistency. Experiments on silk also have given good results; M. Gautillon, of Lyons, has produced some remarkable examples.

Considering the importance of this substance, the society referred it to M. Heilmann for examination, with respect to its application in cotton printing and the dressing of cotton tissues. M. Heilmann has since made a long report on the subject, of which we give the chief points in the most succinct form possible. Haï-Thao begins to dissolve at about 75° C., but the dissolution is only completed after boiling for ten minutes. When cold it forms a jelly like that of gelatine, but after twelve hours or so, it begins to dissolve, and must be boiled again to render it homogeneous. It will then keep for days without fermentation. Boiled with 500 times its weight in water, the solution is pretty thick, but not so homogeneous as when more concentrated. It will dissolve cold, and in large proportions in sulphuric, nitric, and hydrochloric acids, but it is precipitated from these solutions by water. It will not dissolve in alcohol, hot or cold. It has been applied to the dressing of cotton fabrics alone, and mixed with fecula and other substances. Employed alone, and without blue, it gives the fabric a yellow tinge, and even with blue it gives it a slight greenish tint. It begins to give consistency to the tissue when mixed with not more than 300 times its own weight of water; with 100 parts of water it produces a dressing which is supple, and gives body without stiffness; in this form the dressing costs ten centimes per litre, or little more than a penny a quart. Dextrine, at 50 grammes per litre, gives less strength than the Thao at 1 to 100 of water; but 100 grammes of dextrine gives more, and only costs 6d. per litre. Fecula, even at 25 grammes per litre, gives more stiffness than Thao at 1 to 100, but both fecula and dextrine render the tissue harder and harsher than the Thao, and do not cover the fibres like the latter.

An addition of glycerine to the Thao gives a much more soft and supple dressing, and the same is the case when a mixture of fecula and Thao is used; when both glycerine and Thao are used, the effect is better than with glycerine, fecula, and dextrine; the tissue has more body, and is at the same time more supple. An addition of talc to the Thao further increases the unctuousness of the tissue, and much more suppleness than when fecula and dextrine alone are used.

M. Heilmann did not find that Thao rendered cotton tissues impermeable, but calico dressed with it remained stiff, even when impregnated with water.

The *résumé* of the report is, that Thao can not be taken as a substitute for dextrine or fecula when stiffness of the tissue is the sole object in view, either as regards cost or effect; but, on the other hand, it produces a softer and more supple dressing, and it has the effect of more completely closing the meshes of the stuff. Its use is recommended, especially for fine fabrics, but in order to introduce it into general use, the price must be considerably reduced.

[Textile Colorist.]

METHYLANILINE PURPLE UPON CLOTH.

UP to the present time, aniline black is the only useful color which has been formed directly upon the cloth from aniline products; its beauty and remarkable solidity have induced many chemists to try and produce some of the other aniline colors in a similar way, not without hope that if so produced they would be faster than they can be obtained by any known processes of applying the already fully formed coloring matter. The communication of Mr. Albert Depuy to the Industrial Society of Mulhouse upon the production of one of these colors, though it may not prove to be of any practical importance, is well worthy of attention as the first successful though incomplete attempt in a direction where success would be of immense value. He observed that the method by which methylaniline purple (*Violet de Paris*) was obtained by the action of oxidizing agents, such as copper salts, chlorates, etc., had much analogy to the method of obtaining black from aniline, and he hoped that by substituting the methyl product, and using the aniline black process, he would obtain a purple; but only a grey without brilliancy was the result. This was explained by the knowledge that if the purple was ever formed it was at once in the presence of agents which would destroy it as soon as formed, if it had the same properties as the manufactured color.

If, on the contrary, a neutral or basic chlorate of methylaniline (containing three to four per cent of base) was printed and exposed for a length of time to a warm and moist atmosphere, a purple color was developed, the quality of which depended upon the purity of the materials and the conditions of the experiment. But the formation of color was very slow and irregular, requiring eight or ten days. By the addition of a small quantity of red prussiate, not more than one quarter to one half per cent of the color, the purple was developed uniformly and completely in two or three days.

The coloring matter thus obtained directly upon the cloth possesses all the properties of Violet de Paris, allowing for the want of the purification to which the latter has been subjected. It is soluble in water, and if the cloth be exhausted with boiling water it leaves only a grey, which is a secondary product of the decomposition of the methylaniline, or the aniline which was in excess; but the affinity of the fibre permits the purple to be washed with cold water, and even to resist warm soaping. The author concludes by saying that although the process has no probable industrial application, it is adding one color more to those which may be said to belong to the aniline black type, and that there is hope of extending this method of fixing directly other colored derivatives of the hydrocarbons.

NEW CELLULOSE.

By MM. MAGNER and KUNEMANN.

AFTER the cotton or other vegetable fibre has been oleached and cleared of gummy and other matters by the ordinary processes, we convert it into pyroxyline, or powdered cotton, by plunging the cellulose, after being perfectly dried, into a mixture of concentrated nitric acid and sulphuric acid of the requisite density. We then wash it and immerse it while still wet in bisulphite of hydrogen for eight or ten minutes, according to the quality of the cellulose. When it has been again dried, we plunge it in a solution containing 20 per cent of hypophosphite of soda, potash, or ammonia, or other deoxidizing agent. When it has again been washed, the cellulose, thus transformed and chemically azotized, will take perfectly and readily all the mordants' tinctorial matters, as well as animal, or naturally azotized fibres, such as silk, wool, hair, etc., and, moreover, it assumes a brilliancy almost equal to that of silk.

SUBSTITUTE FOR CATECHU IN SILK DRESSING.

M. CHEVALIER, of Saint Thomas, Ardeche, France, makes the following substitute for catechu: Take 100 kilos. of water, 20 kilos. of powdered green or white oak bark, mixed or alone, 2 kilos. of sea-salt, and 10 kilos. of glucose; boil for two hours, and a sirupy liquid will be the result.

GIVING SILK BRILLIANCY AND SOFTNESS.

THIS is patented in France by MM. Gillet and Fils. The process consists in submitting the silk first to the action of the fulling mill and afterwards to that of the Dashwell rotative washing-machine used by printers. The effect of this treatment is to give suppleness without the inconvenience of tangling the filaments, and thus impeding the spinning.

NAPHTHALINE IN DYEING.

M. BALLO, in preparing dinaphthylamine with naphthylamine and bromated naphthaline, heated these two substances in an open mutras nearly to their points of ebullition, and observed that the mass became brown with dark-red reflections. Heating for a long time in the *bain-marie* produced the same result. After cooling, the mass becomes fluid, and when treated with ether left a residuum of a brown color, but which looked blue in their scales, and which, dissolved in alcohol, produced a fine violet.

This is bromated hydracide, with a base which, by the addition of a little ammonia, and a great deal of water, separates itself from the alcoholic solution in the form of brown flocculent masses. If these latter be separated by filtration, redissolved in alcohol, with the addition of a little hydrochloric or acetic acid, and then evaporated to dryness, the hydrochloric or acetate is obtained in the form of a copper-colored crust with metallic lustre. The quantity of this substance obtained is very small, and it is indifferent whether one molecule of naphthylamine to one or two molecules of the bromated naphthaline. On the other hand, air seems absolutely necessary for the production of this violet, for if the alcoholic solution be heated in a closed tube over a lamp, even to the extent of 200 deg. C., maintained for days together, the effect is not produced. It remains to be ascertained whether this new coloring matter can be produced economically.

SALYCILIC ACID.

THIS acid, as produced by the method of M. Kolbe, is being studied by M. R. Wagner, who has already announced various valuable applications to industrial purposes.

In weaving, for instance, this acid will keep the dressing unaltered for a considerable time—a month at least—even in hot weather. It will also preserve albumen for a long time. In dyeing, salycilic acid may be employed in the production of a violet color; and M. A. Dollfuss says that it forms a much more sensitive test for oxide of iron than the sulphocyanide of potassium; the latter is scarcely apparent in a solution of 1·64,000, while salycilic acid in a solution of 1572,000 still gives a violet tint. M. Wagner says that the production of a cheap violet color with the aid of salycilic acid is only a question of time, and he suggests that a violet black pigment, which was introduced some years since into trade by a house at Louisville, Kentucky, under the name of "Gualtheria ink," was probably simply a salycilic acid color.

THE USEFUL APPLICATIONS OF CHEMISTRY.

TWO or three chemical substances afford the master-key to all the passages and chambers of the palace of chemical industries. Sulphur, or (as the Sicilian monopoly of that article taught the British manufacturer) pyrites, the equivalent of sulphur, is necessary for the manufacture of oil of vitriol; a little nitre is also required. Obtaining oil of vitriol, we can now purchase bones, and supply the farmer with one of his most valuable manures—namely, "superphosphate" of lime. The manufactures of glue and bone fat for the soap-maker come into this second step of these manufactures as a subsidiary process. Our oil of vitriol at once affords a start for the manufacture of aërated waters, and it aids the blacking manufacturer, and some other pursuits of similar calibre.

But with oil of vitriol we can convert common salt into sulphate of soda, and thus we inaugurate the manufacture of carbonate of soda from brine, pursuing one of the most useful discoveries with which chemical science has ever enriched the arts of life. Obtaining carbonate of soda, we can now manufacture all the useful salts of soda, and we have, in fact, become independent of all other sources of this alkali. We can now force our soap manufactures into a most robust growth; we can further obtain a basic silicate of soda; and as this silicate of the alkali has the same detergent qualities as the compounds of soda with the fatty acids, we can to a great extent supersede the necessity of fats and oils for this branch of our industries. Our oil of vitriol also enables us to commence the stearine-candle manufacture. But our manufacture of carbonate of soda also affords a supply of hydrochloric acid; this becomes an economical basis for the fabrication of bleaching-powder, and thus facilitates paper-making, and the several arts which concern textile fabrics. Every one of these manufactures stimulates and assists the others, and under their patronage the chemical glass-maker and potter flourish, for they afford to both a permanent trade foundation on which they push their enterprises into other channels. With the ammoniacal liquor of the gasworks and with oil of vitriol, we furnish the agriculturist with sulphate of ammonia, a most excellent administrant of nitrogen to the soil, and therefore a valuable stimulant of his crops; and this sulphate of ammonia, moreover, becomes the basis of the important ammoniacal alum manufacture. Where the lemon flourishes, oil of vitriol would enable us to produce a merchantable citric acid; and similarly, where the grape is cultivated, tartaric acid may be in a similar manner prepared. But examples are almost endless, and the illustrations already given sufficiently establish the proposition which we have advanced.

We have not alluded to the minor manufactures of the finer chemical preparations, to those more delicate, but not more interesting chemical compounds which find a use in the laboratory, or which pertain to pharmacy, photography, or the decorative arts, to the important preparation of the alkaloids, and the extraction and manufacture of essences; it will be sufficient to assert that these also are the outer ramifications of the same growth, and that for their conduct they mostly enlist the use of those staple chemicals which we have enumerated as being manufactured on so large a scale, and as being of so universal an application.

As an instance of the progressive growth of a manufacture, it may be permissible to cite one other concluding example—that, namely, of coal-gas manufacture. It is particularly instructive as an illustration of the certain progressive character of these chemical industries; and it shows, moreover, into what a wide range of uses the waste products of a single manufacture may extend. At the commencement of the present century, the scheme of lighting by coal-gas was smiled at as the proposition of a visionary; yet, by a little helpful patronage, and by the inherent vitality of the scheme itself, it has made way, and become a method of world-wide adoption; and what was, in its first inception, regarded with alarm, is now admitted to be the safest, cleanest, and most healthful of all accessible modes of lighting. The bye products of this method are gas-coke (a useful form of fuel, with which we could no longer dispense); a fetid tar, inferior to that of the spruce pine; gas-lime, foul with sulphur compounds; and an ammoniacal liquor. From the latter, all the salts of ammonia—its carbonate, sulphate, and sal ammoniac—are obtained; the latter, which was once regarded as a precious substance (being at that time sublimed in small quantities from camels' dung) is now plentiful and cheap, and of multiform use. From the coal-tar we obtain not only ethereal naphthas for solvents and for our lamps, but carbolic and cresylic acids—substances valuable as antiseptics; and, besides these, a long array of tar dyes—substances with which wool, cotton, silk, feathers, even soaps, may be dyed, with colors, in most cases, as brilliant, and in some cases more brilliant, than those obtainable from any other known source. The fetid, sluggish coal-tar—

"Like the toad, ugly and venomous, bears yet a precious jewel in its head.

The pitch of the tar distiller is handed over for asphalt pavement, and for other uses, while the beautiful, fragrant, pearly naphthalin, with anthracin and crysene, have been long awaiting a proper vocation, but will soon, if we may judge from their endowments, become ennobled for services of importance.—*George Foord, Melbourne, Victoria.*

THE annual statistical report shows that in the Lowell mills there are 800,000 spindles and 17,500 looms, and there are 10,500 female and 7000 male operatives; 3,100,000 yards of goods are produced per week; 60,000 yards of woollens, 40,000 yards of carpeting, 2500 shawls and 20,000 dozen of hosiery. There are consumed weekly 930,000 pounds of cotton and 152,000 pounds of wool. The number of yards dyed and printed per annum is 89,880,000. Nearly all these items are in excess over last year's figures, and some of them very considerably.

PUMPING MACHINERY AT THE FERRARA MARSHES, NORTHERN ITALY.

WE illustrate herewith the most extensive pumping machinery ever constructed, which has lately been completed by Messrs. John and Henry Gwynne, of the Hammersmith Iron Works, Hammersmith, Eng., for use at the reclamation of the Ferrara Marshes, Northern Italy. The view (Fig. 1) will explain the general arrangement of the plant, while on the opposite page we give an external view of the engine-house, and below a perspective view of one of the four pairs of pumps and engines. For the following description and the engravings, we are indebted to *Engineering*:

"The tract to be reclaimed at the Ferrara marshes covers an area of 200 square miles, and the work which the pumps have to perform is to raise rather over 2000 tons of water per minute, a mean lift of 7 ft. 3 in., the maximum lift being 12 ft. The water thus raised is delivered into the River Volano, at Codigoro, where the machinery is situated. The plant provided to perform this work consists of eight centrifugal pumps disposed in pairs, each pair being driven by a pair of compound engines situated between them as shown by the views we present. It is very easy to state that certain pumps have to raise 2000 tons of water per minute, but more difficult to convey a clear idea of the performance. The following facts we trust will enable our readers to appreciate more fully the work which these pumps at the Ferrara works have to do. When working at the mean lift of 7 ft. 3 in., each of the eight pumps is constructed to discharge 57,000 gallons per minute, the aggregate discharge from the eight pumps when working at this lift being consequently 456,000, or nearly half a million gallons per minute. But 456,000 gallons per minute equals 656,640,000 gallons per day of twenty-four hours, while, according to a late return, the total quantity of water supplied by the whole of the London water-works is a little under 110,000,000 gallons per diem, so that it will be seen that the quantity of water to be dealt with by the Ferrara pumping machinery amounts to six times the whole metropolitan water supply. [The capacity of the present Croton Aqueduct at New-York is 110,000,000 gallons per day. The Ferrara pumping machinery, therefore, discharges six times the quantity of the Croton Aqueduct.] Again, 456,000 gallons, or 72,900 cubic feet per minute, would supply a stream over 100 ft. wide and 4 ft. deep, running at a speed of two miles per hour, or 176 ft. per minute, while the delivery for a single day would also suffice to fill a reservoir a mile square to a depth of about 3 ft. 9 in. Lastly, we may mention that in 1852, when several important water-works Acts were passed, the minimum quantity of water passing down the Thames above Hampton was estimated as 362,000,000 gallons per diem, while in September, 1865, observations showed a minimum quantity of a little over 300,000,000 gallons per day; this latter quantity being less than half that to be lifted by the Ferrara pumping machinery.

"Referring to the views, it will be seen that the four pairs of pumps are arranged in a row, the engine-house communicating at each end with a boiler-house containing five boilers. The perspective view shows the whole of the buildings, while Figs. 2 and 3 on the opposite page will explain the arrangement of the suction and discharge pipes of the pumps, and, in fact, the general arrangement of the whole machinery.

"The pumps have 5-ft. disks, and discharge-pipes 54 in. in diameter. The suction-pipes are double, entering the pump-casings on each side and passing straight down to the supply culverts, as shown in Fig. 3 on the opposite page. The pump-shafts are of steel and about 8¼ in. in diameter; they are, as will be seen from the view below, provided with bearings outside the pump-casings. The volute, or outer part of each casing, is cast in a single piece about 15 ft. in diameter, these volutes being castings which afford good evidence of the capabilities of the foundry at the Hammersmith Iron Works. The construction of the pumps is such that every facility is given for inspection, the removal of the top bend of a suction-pipe enabling the disk to be either examined or withdrawn.

"Each pair of pumps, together with the engines driving them, is mounted on a bedplate formed of three parts, firmly bolted together so as to form practically one structure. The central part, which carries the engines complete, weighs 13 tons. The pump-shafts are connected directly to the engine crankshaft by disk couplings, these couplings having keyed upon them small disk fly-wheels containing the balance-weights. One of these wheels has also a worm wheel fitted with a worm for turning the pumps by hand.

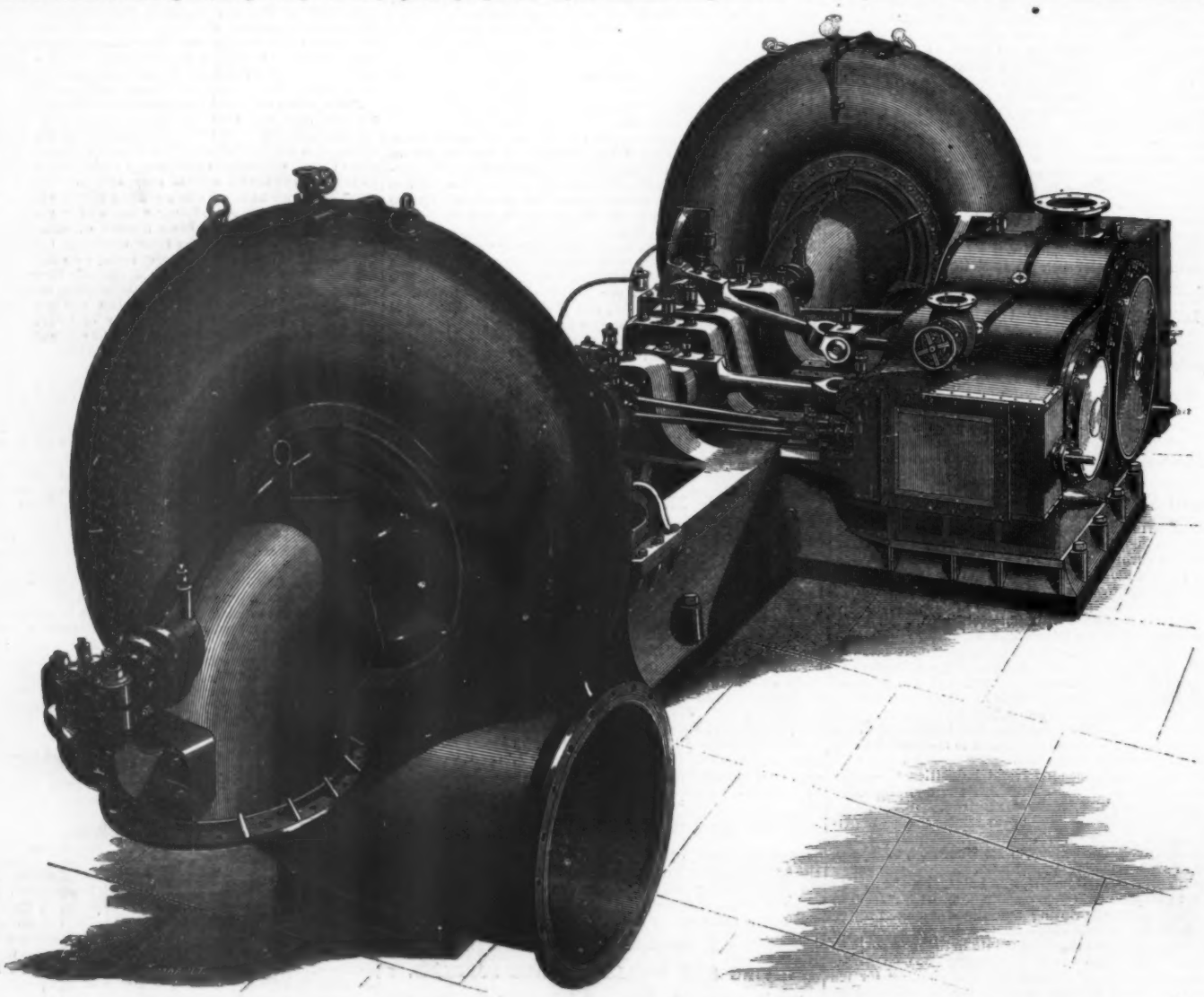
"The engines are of the compound intermediate receiver type, the cranks being placed at an angle of about 130 deg. The diameters of the high and low pressure cylinders are respectively 27¼ in. and 46⅝ in. the stroke being 2 ft. 3 in. The two cylinders of each engine, together with their valve-chests, are made in a single casting, and to secure parallelism, the two cylinders were bored out together by a special boring-machine, arranged by Messrs. J. and H. Gwynne, for the purpose. The cylinders are both steam-jacketed, the jackets being formed by the insertion in the cylinders of liners fixed by an internal flange at one end, and provided with an expansion joint at the other. As will be seen from the perspective view above, the two cylinders are placed together with the valve-chests outside them, and the valve of the high-pressure cylinder has an adjustable expansion valve on its back, while the low-pressure cylinder is fitted with a single valve only.

"From the low-pressure cylinder the exhaust steam passes into a pair of surface-condensers placed one on the discharge-pipe of each pump, as shown by Figs. 1 and 2 on the opposite page. Each condenser exposes 750 square feet of condensing surface made up of a number of 3-in. tubes contained in a cylindrical chamber placed in the line of the delivery-pipe, and connected with the latter by a short conical junction-piece at each end of the condenser. The tube-plates of the condenser are of cast-iron, and have the tube-holes cast in them, the tubes projecting through the plates, and the packing consisting simply of an india-rubber ring placed around the projecting end of each tube, and so spread as to form a joint between the tube and plate. This is a very simple form of packing which Messrs. J. and H. Gwynne have on former occasions used for such condensers, and it is found to serve its purpose perfectly. The condenser tubes are of course traversed by the whole of the water discharged by the pumps, and thus the surface exposed by them is rendered very effective. Each pair of engines has a single-acting air-pump 19 in. in diameter, and with 12-in. stroke, placed vertically below the level of the engine-room floor, and driven by an eccentric on the crankshaft between the two cranks. The sluice-valve, shown in Fig. 2 as being placed on the delivery-pipe beyond the condenser, is worked by hydraulic power.

"We had occasion in a former notice to commend the neat and thoroughly substantial design of the engines and pumps of which we have been speaking, and as regards the workmanship, we can only repeat what we then stated, that it is of the very best class. The engines have throughout large bearing surfaces, and the pump-spindles, connecting rods, piston rods, and, in fact, most of the working parts, with the exception of the crankshafts, are of Bessemer steel.

"The engines are supplied with steam by the boilers arranged in two groups, five in each, as shown by Fig. 1 on 137. These boilers contain each two flues or furnaces united into a combustion-chamber traversed by Galloway tubes, while from this combustion-chamber 108 tubes, 3 in. in diameter and 4 ft. long, extend to the rear end of the boiler. Each boiler has 30 square feet of firegrate surface, and exposes 730 square feet of heating surface, the ten boilers having thus together 300 square feet of grate and 7300 square feet of heating surface. Each group of boilers is also supplied with a Green's economizer arranged as shown in Figs. 1 and 3 on 137, each of these economizers containing 192 tubes of 4-in. bore, and exposing about 2000 square feet of heating surface. Experiments made with these boilers show we are informed, an evaporation of nearly 12 lbs. of water per pound of coal.

"The whole set of engines and pumps we have been describing have lately been subjected to a test of twelve days' and nights' continuous working, without a single hitch or stop of any kind, and—as we should have anticipated from our examination of the machinery before it left this country—with most satisfactory results. We may add that Messrs. J. and H. Gwynne are sending to the Philadelphia Exhibition a beautifully finished working model, made to a scale of 1½ in.=1ft., of one pair of the Ferrara pumps and engines, fitted complete with condensers, sluices, and hydraulic cylinders for working the latter. This model, representing as it does a part of the largest set of pumping machinery in the world, will, we expect, be regarded with much interest.



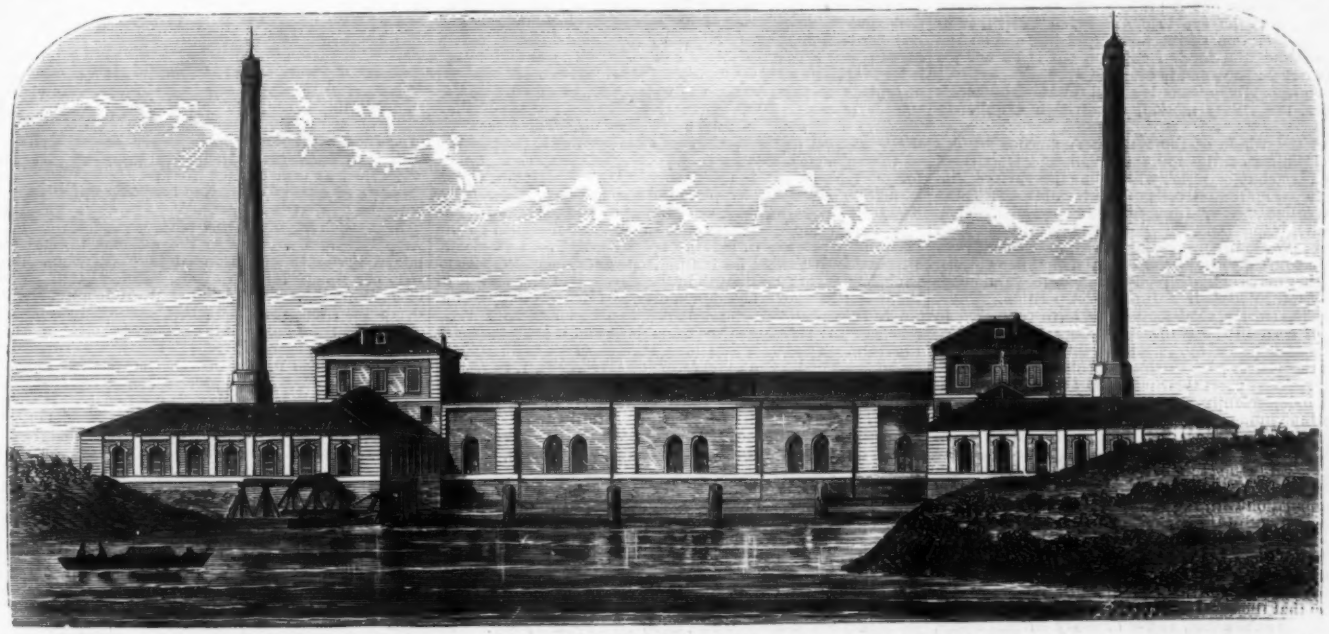
CENTRIFUGAL PUMPING ENGINES FOR THE FERRARA MARSHES, ITALY.

CONSTRUCTED BY J. & H. GWYNNE, ENGINEERS, HAMMERSMITH, ENG.

DRAINAGE OF THE ZUYDER ZEE.

"In concluding the present notice, we may remark that extensive as are the Ferrara reclamation works, a still more extensive scheme is now about to be carried out—namely, the draining of a portion of the Zuyder Zee, having an area of 485,775 acres, or about 759 square miles. The tract thus reclaimed will add nearly six per cent to the area of Holland and as the Chambers have now voted about nine and a half millions sterling for the prosecution of the enterprise, the work will probably be commenced without delay. To enclose the tract to be reclaimed, a dyke 25 miles long, 164 ft. wide at its base, and rising 26 ft. above the water-line, will be made.

the dam starting at Eukhuisen and running in an easterly direction to the island of Urk, thence proceeding to the southeast to the island of Schockland. From the latter island it will be continued to the mainland which it will join at Kampen, just above the mouth of the Ijssel. The area thus enclosed will be divided into squares, which will be successively pumped dry by suitable machinery. We have here merely indicated the general outline of this vast and important work, but hereafter we shall have more to say about it. Meanwhile, we may point out that with powerful pumps driven by engines of a highly economical type, such as those provided by Messrs. J. and H. Gwynne for the Ferrara marshes, these reclamation works become much less formidable undertakings than they formerly were, as the pumping is not only done at less cost, but also more quickly, and hence the capital expended is the sooner rendered remunerative."



ENGINE AND BOILER HOUSE, PUMPING WORKS, FERRARA MARSHES, ITALY. (*See page* 136.)

UNHEALTHY TRADES.

A LECTURE BEFORE THE SOCIETY OF ARTS, LONDON, BY DR. B. W. RICHARDSON.

THE classification I should venture to offer of the injuries springing purely from industrial pursuits, as we find them in this country, is included under the following heads:

I.—INJURIES FROM INHALATION BY THE LUNGS.

(*a.*) *Of fine particles of solid matter.—Dusts.*
(*b.*) *Of gases and vapors.*

II.—INJURIES FROM EXPOSURE OF THE BODY TO CHEMICAL AGENTS.

III.—MECHANICAL INJURIES.

(*a.*) *From Impact of Foreign Bodies.*
(*b.*) *From Burns and Scalds.*

IV.—PHYSICAL INJURIES OF THE BODY.

(*a.*) *From Unnatural Positions.*
(*b.*) *From bearing Weights and Loads.*
(*c.*) *From undue Atmospheric Pressure.*
(*d.*) *From Mechanical Concussions.*

V.—INJURIES FROM EXPOSURE TO DAMP AND TO IMPURE AIR.

VI.—INJURIES FROM CONTACT WITH PARASITIC ORGANIC FORMS.

VII.—INJURIES FROM MUSCULAR WORK.

(*a.*) *Local.*
(*b.*) *General.*

VIII.—INJURIES FROM EXPOSURE TO EXTREME VARIATIONS OF TEMPERATURE.

These series of injuries occurring from the various sources specified may be considered as special to the industrial classes. They are additional to those which befall the other classes of the community as well as themselves. They are additional to those five injurious influences which I described in my last lecture—namely, intemperance, heredity of disease, imperfect food, indifferent moral surroundings, and uncleanliness.

FACTS IN DETAIL.

From the general classification above rendered I may pass at once to some of the facts of detail connected with the respective classes specified. I will, if you please, proceed in order from the first head on the list. This, I fear, will yield subject-matter enough of itself for the present short course of lectures.

As I progress from one line of facts to another I shall pursue the following method. I shall state the nature and character of the injurious influence, and shall then trace out the phenomena of disease that occur from it. This done, I shall place the phenomena under the name which they take in the calendar of disease in what we physicians call the nosology. In this manner I shall, so to speak, extract the pathology out of the industry, and so fix the phenomena in the mind, that the subject, as far as we follow it, may be perfectly intelligible to those who have no technical knowledge of disease and its causes.

CLASS I.—INJURIES TO THE BODY FROM INHALATION OF FOREIGN SUBSTANCES BY THE LUNGS.

Order 1.—*Injuries from Inhalation of Dusts.*—The term dusts, as I would here apply it, includes all those fine, solid particles which are thrown off from various substances in the processes of manufacture or treatment of articles in common use in daily life, such as earthenware utensils, knives, needles; or mechanical instruments, like files or saws; or ornamental things, such as ornaments of pearl, ivory, and turned wood; or articles that are worn, of silk, cotton, hemp, fur; or things that are used for food, such as flour; or for creating warmth, such as coal; or for using as a supposed luxury, such as tobacco and snuff. These are only a few illustrations; many others will naturally occur to those who think on the subject.

The dusts which inflict injury are of varied quality, as will be seen from the brief sketch just given. They are also of varied effect in regard to the specific injuries which they produce. We may profitably study them divided into different groups, according to their physical characters, as follows:

(*a.*) Cutting dusts, formed of minute hard, crystallized particles which have sharp, cutting, and pointed edges. These dusts are composed of iron or steel, of stone, of sand or glass, of dried silicates in earthenware, of lime, of pearl.

(*b.*) Irritant dusts, derived from woods, from ivory, from textile fabrics, fluffs of wool, of silk, of cotton, of flax, and of hemp, from hair, from clay.

(*c.*) Inorganic poisonous dusts, derived from some poisonous chemical compounds used for coloring artistic products, or for preserving organic substances, such as furs. These dusts are charged with arsenical salts.

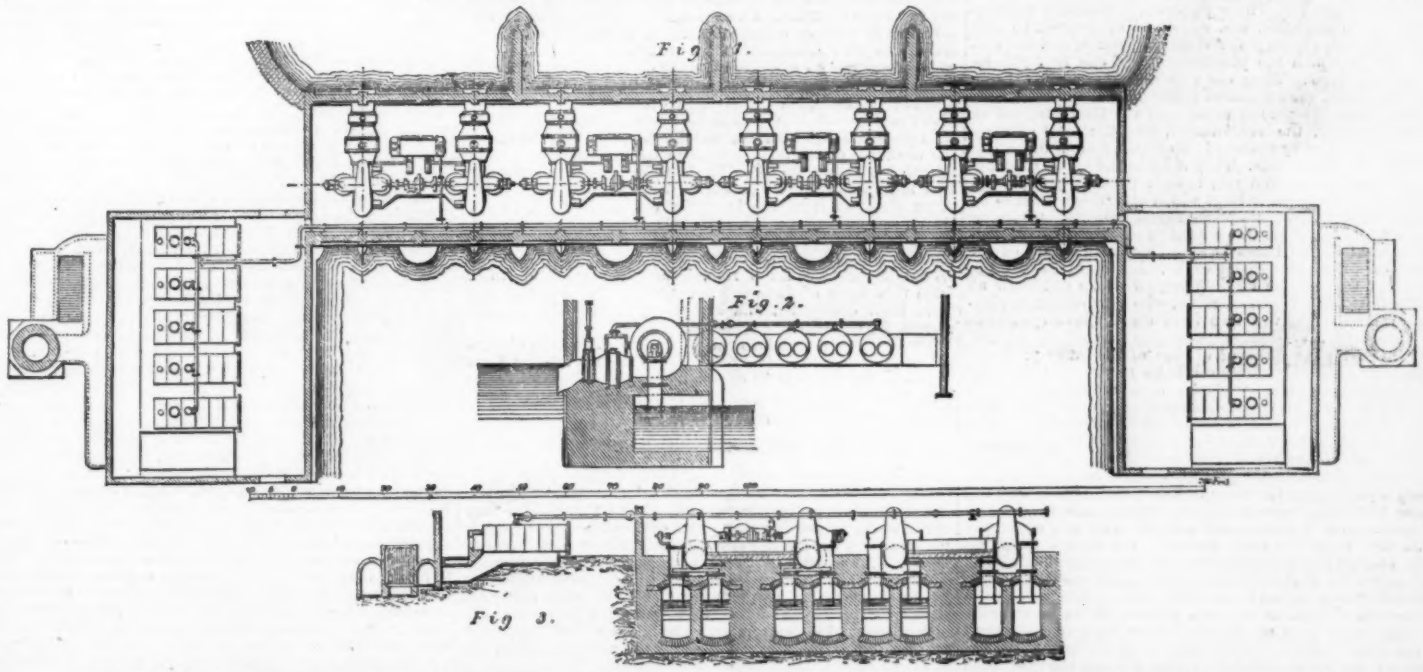
(*d.*) Soluble saline dusts, derived from soluble crystalline substances used for dyeing purposes. The sulphate of iron, copperas, yields a dust of this class.

(*e.*) Organic poisonous dusts, which are thrown off during the making-up of tobacco into cigars and snuff. These dusts carry with them particles of the dried tobacco-plant.

(*f.*) Obstructive and irritating dusts composed of carbon, of fine particles of coal-dust, of scrapings of carbon or of soot, of dust of rouge, and of flour.

Whatever may be the kind of dust to which the workman is subjected, to whichever of the above-named he may be exposed, the primary cause of danger lies in the circumstance that the fine particles are borne by the air into the lungs. They pass, wafted by the air, through the mouth and nostrils into the windpipe; they pass along the bronchial tubes; in some instances they reach and traverse the bronchial passages which lie between the larger bronchial tubes and the minutes air-vesicles, or they even reach the air-vesicles themselves.

We are all of us at times exposed to inhalation of dust, and much harm, even under ordinary circumstances, might occur from such exposure, had not nature provided certain



PUMPING MACHINERY AT THE FERRARA MARSHES, NORTHERN ITALY. (*See page* 136.)

simple but effective measures of protection. These measures are three in number—namely, cough, bronchial secretion, and ciliary motion. Let me for a moment explain these facts.

When a foreign substance or whiff of dust is inhaled, and impinges on the opening into the windpipe—the glottis—an irritation is produced upon the nervous filaments, and a message is sent up to a nervous centre indicating the fact of irritation. The response is a reflex movement upon the muscles, and the expulsive muscular movement known as cough. Then, if it be possible, the foreign agent producing the disturbance is coughed up, and the irritation ceases.

This is the mode of action of the protective measure of cough. At the same time that the substance which causes the cough irritates the nervous fibre so as to produce the muscular expelling effort, it also, by another act, excites, through nervous fibres, these mucous glands of the throat, which are so well depicted in a diagram before you. The glands thereupon throw out a profuse secretion. As when an irritant applied to the eye brings tears, so an irritant in this part brings secretion of mucous or phlegm, and on the tide of that secretion the foreign substance, if it be not too excessive, is carried away, and is coughed up.

To these two protective means is added the third of which I have spoken, the ciliary motion, a provision exquisitely beautiful.

Throughout the whole of the respiratory mucous surface the epithelial lining of the mucous membrane is studded with minute filaments, or striæ, which line the surface, and are attached to the epithelial cells of the membrane. These filaments are called "cilia," from *cilium*, an eyelash. They are very minute, being from the $\frac{1}{2500}$ to the $\frac{1}{3500}$ of an inch in length, and they are in constant movement in one direction, from within outwards, towards the direction of the windpipe and larynx. They move in that direction as far as they can bend, and then they return to their natural erect position. Thus, in a wavy motion (which some anatomists have compared to the waving of corn in the corn-field), they carry the bronchial secretion and any foreign substance that may be mixed with it from the lowest part of the bronchial surface to the outer opening. They exert their movement independently of our will, and independently, it would seem, of nervous force, and they continue in movement for a time even after death.

In damp, foggy days, we breathe in this London air great quantities of fine carbon as smoke, and we notice that for some days afterwards the secretion from the lungs is greyish dark, or even black. That grey color is due to the carbon, which, in combination with the secretion, has been carried by the ciliary motion out of the lungs, and is removed by cough. The ciliary action is so rapid that some experimental observers have argued against the introduction and retention of any large quantity of matters of dust in the lungs under any circumstances. Unfortunately, the records of industrial pathology prove that the beautiful natural provision for the expulsion of foreign substances, under ordinary circumstances, is not sufficient to meet unnatural pressure of work, and that, in spite of it, men die from dust inhaled into the respiratory tract. In those who are exposed to any one of the kinds of dusts I have named, the foreign particle is received by the lungs, is unduly retained, and is a source of danger, from the local mischief it excites.

At the same time, the greatest differences prevail as to the nature and extent of the danger, the differences being dependent upon the character of the dust. In other words, the character of the dust determines the severity of the injury. This is so true that, other things being equal, we may predict the fate of the workers by the nature of their work, when their labor is carried on without efficient protection from danger.

Effects of Cutting Dusts.

When the particles of dust are made up of steel, of fine stone, of sand, of glass, or pearl, the danger is most immediate and most active. These particles, exceedingly minutely divided, are insoluble, and are edged or pointed, so that they actually cut through the ciliary processes, and the epithelial base on which the processes rest. I call them, therefore, cutting dusts. They are also heavy particles. From both these causes the amount of injury they inflict is as acute as it is terrible. Hence the rapidity of the fatal mischief on the knife-grinder, the stone-cutter, and the sand or glass paper maker. The symptoms induced are technically called symptoms of consumption. They are like the ordinary symptoms of that disease, and are, indeed, practically the same, except that the foreign irritant which calls them forth is an inorganic particle, as distinguished from the organic tubercle of the natural affection. The rapidity of action of the particles of steel on the lungs is notorious in the cases of the grinders of Sheffield. The late Dr. Alison, of Edinburgh, recorded of the masons of Edinburgh that he did know an instance in which a hewer of stone, who had regular employment in Edinburgh, was free from consumptive symptoms until the age of fifty.

The most typical forms of disease of the lungs produced by these cutting dusts which I have met with have been amongst those who are employed in sandpaper-making. I am happy to state that great improvements have been made of late years in this process by means of machinery, but at at one time the danger was most imminent. The fine sand, or a mixture of finely-powdered sand and glass, was placed in fine sieves, and youths were employed to distribute the powder equally over the paper. The work is light, and the young, therefore, were reckoned as competent for its performance. In one instance of a youth, who was under my observation from the early stage of his illness until his death, I traced the symptoms from the commencement. The youth was quite well until he went to this occupation, and on the first day he coughed severely from the irritation produced by the dust. When he returned home at night he coughed still, and complained of severe pain in his side and chest. He continued, nevertheless, to toil on in his fatal work, but in a few days was quite stricken down with all the symptoms of acute pulmonary consumption. In the course of three weeks the symptoms had become so severe that life was rendered impossible, and within the month death took place. The symptoms were so closely allied to those of ordinary pulmonary consumption, it would have been impossible to distinguish them from the ordinary disease but from the knowledge obtained as to their cause. The expectoration gave evidence, under the microscope, of the presence of the foreign irritating substance, and after the death of the sufferer, the diseased lungs, in their minute vesicular structures (for the mischief was nearly equally spread over each lung) gave the same fatal evidence of the presence of the foreign particles.

The millstone-cutter, the potter, the needle-grinder, the pearl-cutter, and the turner suffer in like manner from this consumptive malady, similarly induced. In the case of the pearl-cutters, there is also, as I am reminded by Mr. Bartleet, of Redditch, an additional danger from their work—namely, that in Birmingham and other large towns where the pearl-working business is carried on, the industrials conduct their labor in their own small, ill-ventilated rooms, where bad air adds to the risk of the mechanical injury.*

Thus we have to place first on our list of diseases induced by industrial occupation, that formidable malady *phthisis pulmonalis*, pulmonary consumption. It would be a distinctive and no false appellation to give to this type of disease that of mechanically-induced consumptive disease, or, better still, of *industrial phthisis*. This term would fix the malady, in regard to its specific origin, on the official mortality tables, and a more correct record of industrial diseases would be obtained.

From the inhalation of fine particles of pearl, there has been observed on the Continent a peculiar inflammatory disease of the bones, to which the name of "osteitis" has been given. This disease, first described by Englisch, as attacking mother of-pearl turners, has since been studied by Gussenbauer, Klauser, Hirt, and Merkel. Gussenbauer and Klauser have made an analysis of the three different layers of which the pearl shell is composed. The most internal layer is the one used by mother-of-pearl turners. It contains of organic matter insoluble in water 5·57, of organic matter soluble in water 0·11, of water 0·47, of carbonate of lime 93.555, and of alkaline salts 0·295 per cent. The disease of the bones that has been observed as incidental to the turning of this substance attacks only youths, before the skeleton is fully developed. It is characterized by sudden pain, which is neither increased by pressure nor motion. A swelling, first from the periosteum, or covering of the bone, and afterwards from the bone itself, shows itself at the ends of the bones at what are called the epiphyses. The soft elastic swelling is sometimes fluctuating. Its development is accompanied by fever; it enlarges in the direction of the length of the bone; in time it becomes harder, and it rarely suppurates. As a rule, the tumor resolves. It often attacks several points of the skeleton at the same time, and it has a tendency to return. The bones that have been observed as affected in seven cases under the observation of Gussenbauer, in youths of from 14 to 16 years, are the radius of the arm, the ulna, the lower jaw-bone, and the thigh-bone. In one instance several bones were attacked successively in the same subject—namely, the left metatarsal and cubit bones, the left shoulder-blade, the left arm-bone, the humerus, the cuboids, and the right astragulus or heel-bone.

Gussenbauer, to whom I am indebted for these descriptions—the disease not yet having been described in our country—is of opinion that the malady is produced in the following manner: The dust enters the lungs, penetrates the cellular structure of those organs, enters the lymphatic vessels and glands, and is decomposed. Under the influence of the carbonic acid of the venous blood, the calcareous carbonates are dissolved, the insoluble organic matter remains, and is the substance called conchyoline, discovered by M. Fremy. This penetrates the vessels, and is carried by the current of the arterial blood into the minute vessels. In the reduced vessels of the bone at the epiphyses, it finds resistance and deposits there, causing the swelling and the other symptoms which have been described above, and which continue until the foreign body is resolved and removed. Such is the ingenious theory of the origin of the bone disease of the pearl-turner. We need not discuss the theory, it is sufficient to have before us the facts at this moment.

Thus *osteitis* is a second special malady added to the list of the industrial diseases.

Effects of Irritating Dusts.

Dusts of Wood and Ivory.—The dusts of some kinds of wood, to which turners of wood and fine cutters of wood are exposed, are causes of much irritation of the lungs and of bronchial cough. The dust is fine and penetrating, and when it is from colored wood it imparts its own peculiar color to the bronchial secretion. I have seen these phenomena, markedly in the case of mahogany-carvers, in those who carve ornaments for couches and other articles of furniture. The work gives rise to a great quantity of wood-dust, which is constantly inhaled. In carving, the artisan has to keep up a blowing process with the lips, in order to blow away the small portions of wood which he removes with the chisel. This process is very wearying, but the chief complaint made by the worker is of the dust he draws back in inhalation. The mischief is greatly increased in the rooms where the ventilation is imperfect. The cough is usually attended with copious secretion from the bronchial tubes, and I have more than once known the loss from this cause so copious as to cause other symptoms of wasting and exhaustion allied to phthisis pulmonalis and constituting what has been called *bronchial phthisis*. As a rule, however, those who suffer from this form of disease recover when they are removed from their occupation and are placed in favorable circumstances for recovery.

These same observations extend to the phenomena observed as resulting from ivory-dust, but I do not think I have ever seen in ivory-turners or carvers symptoms equally severe with those that are presented by the artisans in wood.

(To be continued.)

FRENCH TOUR OF THE WORLD.

A FRENCH expedition is being fitted out to make the tour of the world in ten months. The excursionists are to visit India, Japan, the interior sea of Japan, Chinese ports, Australia, etc. A special library, with instruments, will be placed on board. The members of this expedition will be exclusively of the male sex. The fare is to be £800, every thing included. The Geographical Society will superintend the management of the enterprise, although it will be supported by private funds, and is altogether a private speculation.

* I am indebted to the same intelligent observer (Mr. Bartleet) for the following letter on the subject of the diseases of needle-pointers:

December 14, 1875.

MY DEAR SIR: In reply to your inquiry about needle-grinders, technically called in the trade "needle-pointers," I have much pleasure in informing you that their occupation may now be considered very nearly, perhaps, taking all things into account, I may say quite as healthy as the other branches of the trade. The work is now chiefly done by machinery, the workman having merely to keep the stone over which the needle wires are passed in proper order and shape, by frequently applying a piece of ironstone to it, and to see that the said wires are kept in proper order for travelling over the stone. A fan of considerable power is used to draw the dust away from the workman, so that it is his own fault if he inhales it. Careless men no doubt still suffer to a small extent, when not closely looked up by their employer or a foreman.

These pointing machines have been in use about ten years, but the fans have been in use more than twenty years, and since their introduction it has been the fault of the men if they have suffered to any extent. Prior to the introduction of the fans the men seldom were able to continue work after about 30 years of age.

I am, my dear Sir, yours truly,

Dr. Richardson. R. S. BARTLEET.

[Building News.]

STEEL IN CONSTRUCTION.

THE employment of steel for building purposes is gradually beginning to assume a place among the *vexatæ questiones* of the architect and engineer. Scientific men have already prophesied that steel will one day take the place of both wrought and cast iron, and the use of this metal in strengthening cast-iron girders and for columns and other constructive purposes is well known, though seldom taken advantage of. According to Rankine, steel is a compound of iron, containing from 0·5 to 1·5 per cent of its weight of carbon. Its qualities of hardness, ductility, and cohesion depend on the quantity of carbon it contains. Wrought-iron contains under 0·5 per cent of carbon, and cast-iron from 1·5 to 4 per cent. A new work on "The Use of Steel for Constructive Purposes," by J. Barba, chief constructor at l'Orient, and translated by Mr. Alex. J. Holley, of New-York, furnishes us with some interesting facts connected with this recently-developed metal, destined to play an important part in modern construction. This writer defines steel to be "a solidified solution of carbon in chemically pure iron." "Cast-iron is a saturated solution of carbon in iron, with an excess of carbon in a state of mechanical mixture. It might be defined as steel containing carbon in mechanical mixture. Gray cast-iron is a slightly carburized steel with much carbon mixed, and white cast-iron is a more carburized steel with less mixed carbon." Thus steel, as well as cast-iron, owe their properties to the presence of carbon either mechanically mixed or in solution with the iron. Other foreign matters exist which affect the quality, such as phosphorus, silicon, sulphur, manganese, etc. According to Dr. Downing, the ultimate tensile strength of mixed Bessemer steel adapted to construction is about 38 tons per square inch, or about double that of wrought-iron of good quality. As to compressive resistance, Mr. Fairbairn gives 100·7 tons per square inch as the ratio compared with its tensile resistance. It may safely be said to have nearly double the strength of wrought-iron in this respect; and experiments made by Mr. George Berkeley on Bessemer steel cylinders, detailed in the proceedings of the Institute of Civil Engineers, Vol. XXV., may be referred to. It is found that when the carbon exceeds 1·25 per cent, the steel gets weaker, and approaches the condition of cast-iron. Before Mr. Bessemer invented his process, the use of steel was confined to articles of cutlery, etc. Mr. Bessemer's process has reduced the cost of manufacture at least 50 per cent. We will not here allude to the manufacture, but proceed to show some of the important uses of steel to the architect and engineer, first noticing a few of the properties of the metal. The steel employed by France and England for building large ships may be classed as soft steel; and the constructors of the English navy demand for their steel-plates a tensile resistance of 32·9 tons per square inch in the direction of the fibre and 29·8 tons perpendicularly thereto. The resistance should in no case, says Mr. Holley, exceed 39·9. Kirkaldy, an authority, says that steel when slowly fractured presents a silky fibrous appearance; when suddenly fractured, it is invariably granular and free of lustre, and the fracture takes place at right angles to the length. With a fibrous fracture, the angle diverges more or less from 90°. Steel is reduced in strength by being hardened in water, while the strength is increased greatly by being hardened in oil, especially when heated highly. "Steel plates hardened in oil and joined together by rivets are fully equal in strength to an unjointed soft plate; or the loss of strength by riveting is more than counterbalanced by the increase of strength by hardening in oil." The steel should be heated uniformly to a temperature corresponding to bright heat. For constructive purposes, soft steel is best; and in the process of annealing, the temperature must not be too high, or the fibrous texture of the metal is changed, and it becomes less elastic. In some cases, tempering is followed by an incomplete annealing, which changes the molecular structure, "while preserving in the metal the greater part of the properties due to tempering—namely, hardness, tenacity, and a homogeneous composition. Afterwards, more or less annealing is given, according to the degree of elasticity which is to be restored." Complete annealing destroys all brittleness; armor-plates are subjected to partial annealing. Mr. Holley alludes to the extensive employment of Bessemer and Martin steels, which are largely taking the place of wrought-iron. The London and Northwestern Railway has adopted this steel for nearly all purposes, and on the Continent the same eager desire is shown to use this metal for rails, for boiler and ships' plates, beams, channels, and angles of ships, bridges, and other structures. Both in America and England, wooden bridges for railways and highways must sooner or later be replaced by wrought-iron or steel. Which metal must have the preference is a question that must be determined before long, and we think a commission would be well occupied in settling it before any more costly works are undertaken in iron. By a proper heating and manipulation, steels can be made completely tractable, and fit for any purposes of the architect and engineer. Mr. Holley remarks: "It has not probably occurred to many boiler-makers, who could do nothing with steels of rail grade and below, and so have condemned steel altogether, that shearing and locally hammering plates put them in a condition similar to that produced by cold punching, which reduces the strength of the parts most affected above 20 per cent. Nor has it, perhaps, occurred to engineers who believe in steel, and are anxious to give it a fair chance, to dispense with that class of smiths who can not be told any thing about the treatment of steel, and will not yield to any new requirements." In stamped work, steel offers great advantages over iron, in being able to be cut across the grain. It is found that beams and angles of uniform section harden under the last passes of the rolls, but that beams with very thin flanges are liable to break. The author, M. Barba, gives some useful conclusions as to the treatment of this metal: 1st. Avoid local pressures in working cold steel. 2d. If local pressures must occur, remove their effects by annealing—not once, but as often as dangerous pressures are produced. The *rationale* of this treatment is that steel is denser than iron, and requires more humoring in its cold state; but when it assumes the working shape without internal strains, it is far stronger and safer. For constructive uses, the steel, as we have said, should be mild and tenacious, and capable of resisting concussion. For this purpose, the percentage of carbon should be small. In riveted structures, the shearing strength of steel rivets may be taken at one fourth less than their tensile strength. For steel plates, the rivets of steel should be larger than iron ones.

The advantages as regards strength, both when used for compressive and tensile strains, point to a future for steel which the architect may turn to account. Wrought and cast iron have at present the run, though the shortcomings of those metals under certain extreme conditions have added their weight to those artistic prejudices which the profession have entertained in respect of it. The dangers attending the

use of iron in building, when exposed to a fire, are considerably reduced in the case of steel, which can withstand a fierce heat with impunity, and is not subject to crack and twist like iron when suddenly cooled by water. Again, one argument in its favor is its greater strength, both for beams and columns, enabling the architect to use it as the skeleton of his structure with considerable advantage. Thus, a steel column may be encased in some less conducting material, and be of such slight proportions that no economy of space could object to it. For beams and girders, tension-rods, struts, and flanges of the same material may be combined with cast-iron, and secure all the merits of increased strength with greater lightness. Our advanced architects now consider the only proper mode of making iron fire-resisting is to envelop it in some non-combustible and bad-conducting material; and this mode of making the most of iron and steel can also be defended on art grounds—a position upheld by those who say our architectural construction should resemble the economy of nature in the distribution of bone, muscle, and flesh. The whole question of metallic construction is a great one, and possibly another century will pass before the metals will take their fair share in architecture. We are bound, however, to admit the advantages of steel and iron, and to record facts which another age will make its heritage.

[Engineering.]

THE REDUCTION OF IRON ORES.

FOR some little time past considerable attention has been directed toward the manufacture of wrought iron and steel direct from the ore, and it is believed by many metallurgists that this mode of manufacture will eventually be carried out with satisfactory commercial results, notwithstanding the difficulties which have to be overcome. Under these circumstances it may not be without interest if we review some of the efforts which have been made in this direction, and show how in many cases modes of procedure have been proposed, forgotten, and re-invented. As is well known, the manufacture of wrought iron direct from the ore is the oldest of iron manufacturing processes. It was carried out by the ancient Celts in the lump or "wolf" furnaces, of which traces have been found in Central Europe; it has been employed for centuries in Burmah and India, and it is still used in the last-mentioned countries, and in a few out-of-the-way places in the Pyrenees and Southern Europe, where the Catalan forge is employed. One great objection to these older processes is the loss of iron which they involve, in the Catalan forge nearly 30 per cent of the iron which the ore contains being carried off in the slag. In the ordinary blast-furnace the silica contained in the charge can be fluxed by the addition of lime, but in the Catalan forge and its equivalents the temperature available is too low for the proper melting of earthy silicates, and hence the silica present has to be eliminated principally by an expenditure of some of the iron. In such forges, if the slag is not sufficiently fluid, small additions of powdered ore are made to it for the purpose of adding iron, and thus getting the necessary liquidity. The action of this slag, containing a highly basic silicate on the spongy masses of reduced metal, is to prevent the combination of carbon and the production of cast-iron, while on the other hand when such slag comes into contact with molten cast-iron, it acts upon the combined carbon of the latter, causing the production of carbonic oxide and metallic iron. Under the above-mentioned circumstances a rich ore is evidently essential to the carrying out of these direct processes. We mention these points because they have a bearing upon some of the later plans proposed.

An examination of the records at the Patent Office shows that as long ago as 1736 the manufacture of wrought-iron by a direct process, in an open-air furnace, was made the subject of a patent. The patentee was Kingsmill Eyre, and his patent, which is No. 553 Old Law, indicates an advanced knowledge as to the conditions to be satisfied, so much so that we quote his specification at length, *verbatim et literatim*. He says: "The ironstone or ore being calcined, and the coal charked, are pulverized and mixed together, and put into an air-furnace, with the additional fluxes of lime and the ashes of fern, which thins the slagg, and causes a ready separation of the metall when it begins to come into the nature of iron. There is then added, according to the quality of the ironstone or ore melted, whether red short or cold short, or the sort of iron to be produced, a certain small quantity of old rusty iron, called scraps, or bushel iron, or nut iron, or hammer slough, whereby more metal is extracted out of the ore than it yields without that addition. It expedites the operation in the furnace, saves fuel, and meliorates the iron, bringing it to a greater degree of fineness and softness than usuall." Whether or not Eyre ever carried out his process in practice we have been unable to ascertain, but his specification reads as if he had some practical experience with his mode of procedure, and it evinces, as we have said, considerable knowledge of the conditions to be fulfilled.

A few years later—namely, in 1771—another patent for making wrought-iron direct from the ore was taken by a John Cockshutt, who proposed to employ a kind of finery fire for that purpose; while, in 1791, Samuel Lucas patented a mode of making steel direct from rich ores by mixing the latter with carbonaceous substances—horn or bone-dust—and heating the mixture in closed melting-pots. Lucas states that four bushels of the cementing substances answer for a ton of ore, and that the result of the treatment is a mixture of metal and earthy matters, the greater part of the metal being converted into cast-steel and being capable of being run into ingots. A few years later, namely, in 1800, David Mushet also patented the production of cast-steel "by the fusion of malleable iron or iron ore" in crucibles, mixed with carbonaceous matters and certain fluxes, and we believe that Mushet made some good steel from ores in this way. In 1819, too, John Thompson patented "processes wherein the use of the blast and melting furnace is avoided," the mode of treatment being to pulverize the ore—by preference calcined—and then wash it to remove, as far as possible, the earthy particles, the washed ore being subsequently mixed with lime, and, by preference, with about four or five per cent of black oxide of manganese. The mixture was then to be placed in an air-furnace with alternate layers of coke or charcoal and stirred while melting. Thompson seems to have contemplated the reduction of the iron in the ore to cast-iron and its subsequent puddling in the same furnace, and, so far, his process can perhaps scarcely be termed a direct one.

Again, Sanderson in 1838, Clay in 1840, Knowles in 1849 and again in 1852, Bellford in 1854, Chenot in 1856, and Gurlt in the same year, all patented modes of obtaining wrought-iron direct from the ore; while, in 1855, Congreve patented the use of a rotating heating cylinder for deoxydizing ores prior to their admission to a reverberatory furnace. William Neal Clay, whose patent of 1840 we have just mentioned, deserves special notice, as he not only patented his process, but made considerable progress in its practical development. His plan consisted in mixing rich ground or broken ore with carbonaceous matters, and heating the mixture in a puddling-furnace, pig or scrap-iron being sometimes added to the mixture when the latter was well heated. The process patented by Sir Francis Charles Knowles in 1852 is a similar one, fluxes, however, being added to the mixture, and the patent is chiefly noticeable for its defining the proportions of these fluxes to be used with different ores. About 1856, too, the manufacture of iron by heating a mixture of ore and charcoal in vertical chambers of small section traversed by the products of combustion of a reverberatory furnace was carried out at the Ebbw Vale works, and we believe a good product was obtained.

Within the last few years several modes have been proposed for producing wrought-iron and steel direct from the ore by treating the latter in closed vessels, and it is noticeable that the leading features of many of the older plans have been revived with improved arrangements of furnaces and mechanical appliances. These later plans have most of them been noticed from time to time in our pages, and it is unnecessary therefore that we should describe them, but we may remark that although some highly promising results have been attained, none of the processes can yet be said to have reached the stage of commercial success. At the present time Blair in the United States, and Siemens and Crampton in this country, are giving special attention to the subject, the first-mentioned having in view the production of an iron sponge, and the two latter the reduction of the metal as a pasty mass which can be treated under the hammer. Dr. Siemens especially has devoted great attention to the perfecting of a direct process, and the opinion, which we believe he holds, that the process will ultimately be found the best and cheapest for making steel, is entitled to much respect. Both Dr. Siemens and Mr. Crampton employ revolving furnaces, the former using gas and the latter powdered coal as fuel, and as each is capable of readily controlling the quality of the flame as well as the temperature, they have a great advantage not possessed—or at all events possessed in a very imperfect degree—by the older experimenters using hand-fired furnaces.

One difficulty to be dealt with in carrying out the reduction of the ore in rotating furnaces is the keeping of these furnaces in sufficiently good repair to insure continuous working. The dust produced in the operation has of course a tendency to clog the apparatus, and if frequent stoppages occur commercial failure must be the result, however good the quality of the product may be. The blast-furnace, on the other hand, is an appliance which has been well tested, and which is not subject to sudden derangement, while it possesses the immense advantage of dealing with large quantities of materials and of getting rid of the slag in a very convenient manner; and although the first cost of blast-furnaces and their accessories, with the equivalent number of puddling-furnaces, is considerable, it is questionable whether it is as great as that of furnaces for turning out the same quantity of product by the direct process. In making these remarks we have no desire to disparage the direct process, but only to direct the attention of those who are working in this direction to the great necessity of producing arrangements which will not only effectively reduce the ore, but will stand continuous work with moderate wear and tear. It is undeniable that Dr. Siemens by his gas-furnace, and Mr. Crampton by his system of burning coal-dust, are placed in possession of facilities which are calculated to have a most important influence in the successful solving of the direct reduction question, as there are few processes in which the control of the temperature and the quality of the flame are of more importance; and this being so the investigations which these experimenters are carrying out will be watched with great interest. We may add, in conclusion, that whatever doubts may exist as regards the ultimate commercial success of any of the direct processes hitherto proposed when worked on a large scale, there are certainly circumstances where they may in all probability be applied to the production in moderate quantities of a high-class material, any interruptions in the working being in such cases of minor importance.

NEW PROCESS FOR IRON AND STEEL.

By E. A. and J. A. JONES, Middlesbrough, Eng.

CONSISTS in first effecting the partial reduction or removal of the carbon, silicon, and phosphorus, or a portion of any one of them, contained in the pig-iron or metal in a cupola or other furnace, and then effecting a further reduction or removal of a further portion of the carbon, silicon, and phosphorus contained in such metal in a rotary or mechanical furnace, the iron or metal from such cupola or other furnace being charged, in a molten state, into a rotary or other furnace where puddling is effected by mechanical means in such manner that iron or steel may be obtained.

[Journal of the Society of Arts.]

AMERICAN OYSTERS IN ENGLAND.

CONSIDERING the popularity of the oyster as an article of luxury, and the fact that of late years good English varieties have become very scarce, and consequently very dear, it is somewhat strange that the public has not paid more attention to those which for some time past have been imported from America. It is now about six or seven years ago that an enterprising dealer in Billingsgate obtained a large consignment of these oysters, but for some reason or other, the experiment was not persevered in. In 1872, Messrs. Miller & Co., of Liverpool, revived the attempt to introduce American oysters to the English public, and some success attended their efforts; but, in consequence, probably, of several other dealers putting bad specimens into consumption, the prejudice which always existed against them increased. The Conway Company, however, persevered in the matter, and relaid large quantities of American oysters in the Conway River, from which it takes its name, but it being found that the land water from time to time caused the beds to be sanded over, the company transferred their operations to Cleesthorpes, at the mouth of the Humber, whence the dealers now obtain their supplies, though a large quantity of oysters are consumed without their being relaid at all. A further attempt to popularize American oysters in this country has more recently been made by the "Wheelbrand" Company, of Liverpool, some samples of whose oysters were recently submitted to some members of the Food Committee of this Society.

The "Wheelbrand" Company import the oysters in bulk for the wholesale trade, and also in kegs of 100 or boxes of 50, for private customers, which are delivered just as they are packed in America. The oysters will keep alive for about a month after being dredged, so that after their voyage of about ten days across the Atlantic, there is a fortnight or more left to dispose of them. By the way, it would be interesting to know how the Romans in olden times transported British oysters, of which they were very fond, to Rome. Whether the American oysters show much improvement after relaying in English waters may be a question, an eminent pisciculturist being of opinion that though the shells grow, the fish inside do not, at least to any appreciable extent. He also maintains, what, if true, is a curious fact in natural history, namely, that American oysters will not breed in our waters. Nor, indeed, is there any apparent necessity for relaying them, for being hardy oysters, they suffer but little by being out of water for a month. The varieties of oysters imported some years ago by Messrs. Miller included the "Morris Cove" from New-Jersey, the "Norwalks" from Connecticut, the "Saddle Rocks," a particularly fat oyster, the "Blue Points," a small oyster, and others from the coasts of Virginia and Maryland, and these probably form the main bulk of the American importation at the present time. But after all it does not matter much what kinds are imported, for American oysters do not differ in quality and price like our own, and therefore it appears hardly worth while for the importers to give the names of English, Scotch, and Irish varieties to their importations. As to the character and flavor of the American oysters, it may suffice to say, that they are full of meat, which is very tender, the cartilage and beard being particularly soft, thus showing a strong contrast to many of our home varieties, while the flavor is very distinctive. The distinguishing taste of our own oysters may be described as "coppery," but that of the American has a decided flavor suggestive of the English mussel. This may not seem a commendation; but, after all, the old adage, *de gustibus*, etc., must be borne in mind. Americans prefer the flavor of their own best "natives," and, perhaps, after becoming accustomed to it, the English public may learn to appreciate the peculiar flavor of the American bivalves, which, by the way, is not so pronounced if the oysters are eaten in any cooked form. The price of the American oysters averages, retail, about one penny each, and this price compares very favorably with that of our common varieties. In order that any readers, who may feel disposed to experimentalize on American oysters at an oyster-bar, may be sure that they are getting what they ask for, it may be mentioned that there is a black mark about the size of a sixpence on both shells where the cartilage adheres to them. This is a "trade-mark," as it may be called, whereby all American oysters may be infallibly known.

It is to be hoped that the attempt to familiarize the oyster-eating public with the American rearing will be persevered in; and, in the mean while, there seems much need of improvement being made in the modes of transport, in their treatment on arrival here, and relaying in English waters. The oyster is so excellent a luxury, and so digestible and nutritious as an article of food, that it is well worth considerable trouble being expended on it with a view to increase the supply. A large and regular importation from America would enable us to spare, in a measure, our own home resources, and give our own beds further opportunities of recuperating themselves.

DEFENCES OF LONDON.

THE newly-built powerful forts on the banks of the Thames between London and Sheerness have had their armaments completed within the last few days. These consist, in some cases, of 38-ton, and in others of 9-inch or 12-ton guns, which in all cases are mounted upon the patent carriages, by the machinery of which the gun can be elevated or depressed, or its position changed with the utmost facility. As bearing indirectly upon the defence of the metropolis, it may be stated that the first of the forts which are to be erected on the heights above the Medway at Borstal, Rochester, intended to form a chain of land defences for Chatham, will be shortly commenced.

LODGES AND COTTAGES.

(See illustration on page 140.)

A RECENT number of the *Building News*, London, contains a selection of entrance lodges recently built from designs by Mr. Arthur Vernon, architect, High Wycombe, some of which will doubtless be found interesting and useful to our readers. The *News* says:

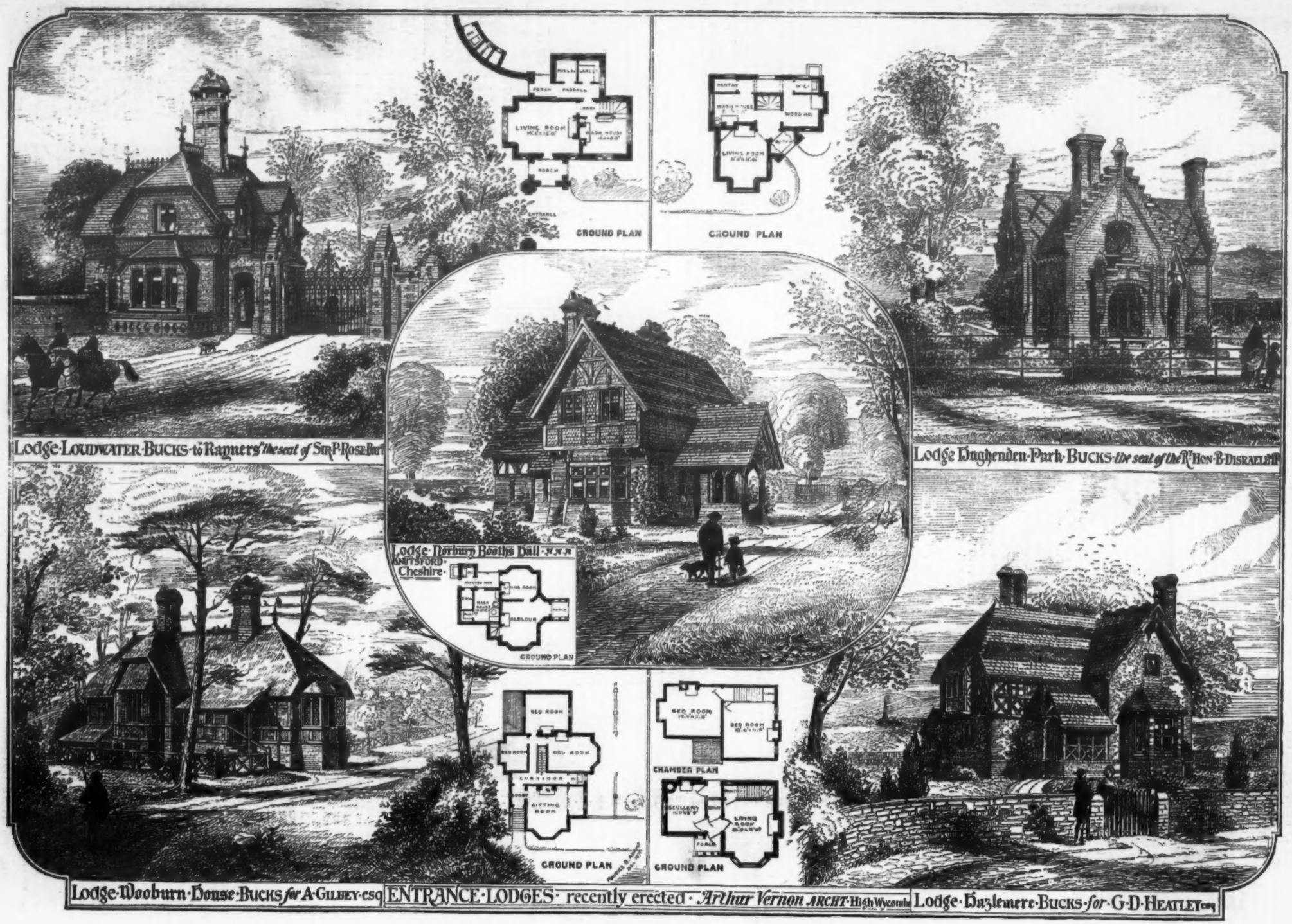
"*Lodge, Hughenden Park.*—This building has been recently erected for the Prime Minister. It forms the principal entrance lodge to Hughenden Park. In design it is intended to correspond somewhat with that of the mansion, and the materials—of brick with stone dressings—are similar. The lodge contains six rooms, and, to avoid unsightly outbuildings, all necessary office accommodation is also arranged under the same roof. From its site there is an extensive view of the Hughenden Valley, and the sylvan charms of the park and manor-house which have been so long associated with Mr. Disraeli's name.

"*Entrance to 'Rayners.'*—From the London and Oxford road this lodge, with the gateway, forms the principal entrance to Rayners, Bucks, the seat of Sir Philip Rose, Bart., which is on the summit of the Penn Hill, about two miles distant. The lodge contains three good bedrooms, parlor, kitchen, and ample offices. The materials are of white Suffolk bricks in the dressings, with axed flintwork panels, and ornamental bricks, of Pethers' patent designs, freely used in the strings, arches, cornices, etc. The roofs are covered with Broseley dun-colored tiles, surmounted by Macfarlane's iron ridging.

"*Wooburn House Entrance Lodge.*—This lodge is a large rustic building serving the double purpose of a gatekeeper's house or a summer residence for visitors. It contains ten rooms, some being of ample proportion, the position and half-sunk basement giving it, however, the appearance of a smaller size than it really possesses. The basement walls are of thick brickwork, and the structure over is of rustic fir-work, with felt and boarding inside and battened. The roofs are of thatch. It has been lately erected for Alfred Gilbey, Esq., adjoining the high road from Wooburn Green to Marlow.

"*Entrance Lodge, Hazlemere.*—This building is placed at one of the entrances to Hazlemere Lodge, near High Wycombe, Bucks, the property of G. D. Heatley, Esq. It occupies an exposed position on the hill-top. The materials are flint and white bricks, with slated roof and widespreading eaves. The lodge contains six rooms and outbuildings.

"*Norbury Booths Entrance Lodge.*—This building is in course of erection as a new entrance lodge to Booths Hall, Knutsford, Cheshire, the property of J. P. Legh, Esq. It adjoins the Chelford road, and is placed among the stately timber that skirts the park. Accommodation is given on the ground floor for parlor, living-room, and scullery, with out-offices, and for three good bedrooms over. In design it has been intended that the building should harmonize with the half-timbered examples in which Cheshire so richly abounds."

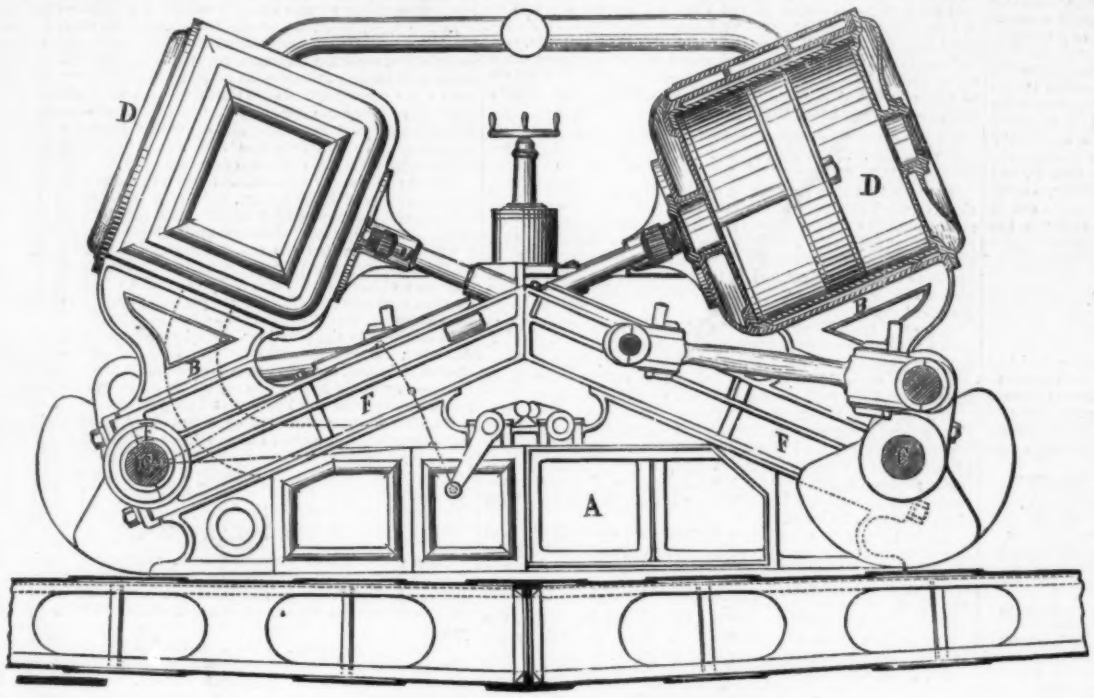

GROUND PLAN
GROUND PLAN
Lodge Loudwater Bucks to Rayners the seat of Sir P. Rose Bart
Lodge Hughenden Park Bucks the seat of the Rt Hon B Disraeli MP
Lodge Norbury Booths Hall Knutsford Cheshire
GROUND PLAN
CHAMBER PLAN
GROUND PLAN
Lodge Wooburn House Bucks for A Gilbey esq
ENTRANCE LODGES recently erected Arthur Vernon ARCHT High Wycombe
Lodge Bazlenere Bucks for G D Heatley esq

LODGES AND COTTAGES IN ENGLAND.—(*See page* 139.)

IMPROVEMENT IN ENGINE FOR TWIN SCREW-PROPELLERS.

By G. B. WHITING, Washington, D. C.

THE nature of the invention consists in making the condenser-chest and channel-plate the bed of the engine, and upon suitable frames and brackets resting thereon are placed the cylinders and valve-chests, opposite and inclined to each other, with their respective crank-shafts and connecting-rods working under the opposite cylinders, the crank-shafts being



NEW ENGINE FOR TWIN SCREW-PROPELLERS.

mounted on bearings, also supported from the condenser and channel-plate.

A is the condenser-chest and channel-plate, which serves, also, as the base-plate of the engine, on which the pillow-block frames F F F and brackets B B are supported and secured thereto. C C are the crank-shafts, supported in bearings E E E on the frames F F F. The cylinders D D and their counterparts are placed over the crank-shafts C C, opposite and inclined to each other in reverse directions, and rest upon and are secured to the brackets B B, etc., which are also further secured, by suitable bolts, to the frames F F. To the frames F F are also secured or cast the guides for the cross-head.

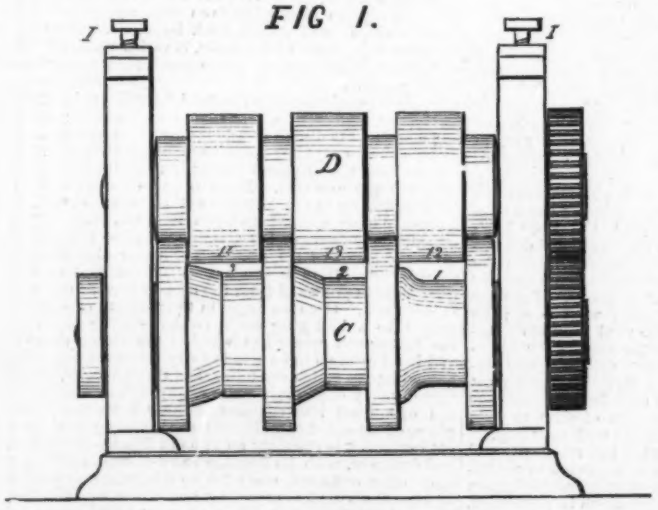
The other parts of the engine are of the usual construction.

ROLL-WELDING IN THE MANUFACTURE OF STEEL-EDGED IRON CUTTERS.

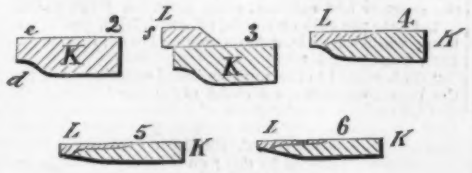
By L. HARDY, Worcester, Mass.

THE bar of iron K, to which the steel is to be welded by rolling, is first rolled, so that a cross-section of the same will

FIG 1.



ROLL-WELDING.



ROLL-WELDING.

be represented by Fig. 3, said bar having one of its corners *d* rolled in, as indicated. The next process consists in placing a bar of steel, L, longitudinally upon the edge *e* of bar K, one edge, *f*, of the steel bar projecting over the edge of the iron bar, as shown in Fig. 4. One end of such pile is run into the furnace and heated sufficiently to enable the ends to be welded together by a few blows. Both bars are then run into a furnace of sufficient capacity to receive and heat their entire lengths, and the bars are allowed to remain in such furnace until they are brought to a red heat at least, after which they are removed from the furnace, and borax is applied on and into the joints between the bars. The bars are then returned to the furnace and raised to a welding heat, after which the bars are withdrawn and placed between a pair of clamping-jaws, by means of which the bars are firmly clamped together, thereby causing the iron and steel surfaces to adhere to each other. The pile is then run into the furnace again and raised to a welding heat, after which the pile is removed from the furnace and run endwise between projection 12 on roll D and the cam-surface 1 on roll C, the lower side *n* of the bar of iron being down or upon the under side, while the steel bar is upon the upper side. After the bars have passed once through the machine, the steel and iron are welded together and caused to assume the relative positions and form shown in Fig. 5. The bar is then passed back and run through between the surfaces 2 and 13 of the machine, when a cross-section of the welded bar at this stage of the process is represented by Fig. 6. The bar is then passed back and run through between the surfaces 3 and 14 of the rolls C and D, when a cross-section of the bar will show the relative positions of the iron and steel, as indicated by Fig. 7, and if it be desired the bar can be passed back and run through between the surfaces 3 and 14 again, the operator turning down the adjusting-bolt I a little, on the left-hand end of the machine, to cause the steel edge *o* to be rolled somewhat thinner, and to give the bar a smoother and more finished appearance than it had after passing for the first time between said surfaces 3 and 14.

It will be observed that the iron is rolled or forced back from under the outer edge of the steel, while the steel itself is rolled down and spread out upon the plane side of the bar, whereby great economy in the use of steel can be practiced, while at the same time obtaining a proper backing of iron and sufficient steel to produce a good cutting-edge when it is ground off to the usual bevel.

A SAXON LADY'S GRAVE.

AT a recent meeting of the British Archæological Association, London, Mr. J. Tom Burgess delivered an address on the Saxon cemetery at Longbridge, especially with reference to what appeared to be the grave of a Saxon lady, from which we quote the following:

"It was impossible to ascertain the size and dimensions of the grave exactly; but, as far as it was possible to judge by the disturbed earth, this lady of the past was not more than 5 ft. high. Of her bones nothing remained save a few teeth scattered in the amber-tinted gravel, but on what appeared to have been her breast was a large disc of gold, 2 in. in diameter, which had evidently been appended to some other ornament by wire or string. This other ornament was evidently a few amber beads, of somewhat rude workmanship, one of which was of so much brighter color as to lead to the belief that it was a ruby or garnet of great value; it was, however, so friable that great care was necessary to preserve it whole. In the grave was found also a large fibula, and a handsome silver bracelet or armlet of excellent workmanship; but it was not until these were cleansed from the dirt that their rude beauty was made apparent. On careful examination it appeared that the gold pendant was ornamented by a series of figures formed by a punch, or rather by a series of punches used singly to form the general pattern. The outer markings were not unlike the plain indentations on the rims of modern coins; these were followed at varying widths by slight curves and a ball not unlike a comma, laid flat; then surrounding an ill-defined ring of 1 in. in diameter were a series of ball and tassel marks irregularly punched from the front. The central pattern was marked from the back, and if it can be likened to any thing, it is like a number of birds, beasts, fishes, and reptiles mingled together. It weighs 5 dwts. 18 grains, and is of pure gold of a rich color.

"There was found also a smaller disc or bracta of silver, bearing a pattern formed by the same set of punches, but differently arranged. The centre is formed by what appears to be a small rowel-spur. This was so friable that the various portions found have been with difficulty preserved. The interest of the collection centres in the silver bracelet, which is 2 in. in diameter by 2½ in., and is formed of one strip of silver 15 in. long, bent so as to form a double ring round the wrist. The silver is only about ¼ in. broad on its narrowest side, but swells into three distinct flutes or rolls where the broad parts overwrap each other, and by this means presents a band of silver in front, nearly 1½ in. wide, of 6 flutings when the bracelet is on the arm. These flutings are ornamented with stamped markings like the silver plate, and there is no doubt that they were executed by the same tools, though the pattern is differently arranged.

"This Saxon lady, who, from the style of her ornaments, must have lived in the fifth, or at least early in the sixth century, was richly adorned. But whether she was one of those daughters of the chiefs who ministered in the rites of Odin or of Thor, no one can tell; but for at least thirteen centuries the little Fisher brook has murmured her requiem as it hurried by to the Avon, which has washed the south side of her burial-mound."

STEAM IN PETROLEUM-WELLS.

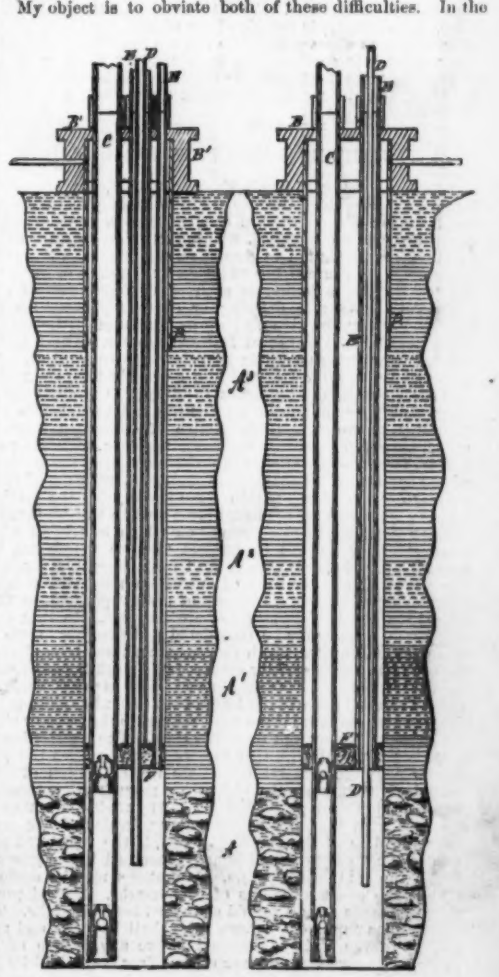
By W. L. HARDISON, St. Petersburg, Pa.

UNDER some circumstances the flow of oil in a petroleum-well is greatly retarded by the deposit of paraffine upon the walls, and the use of steam has been resorted to for the purpose of removing such paraffine.

But serious difficulties are sometimes encountered in this use of steam; for instance, in some wells, salt water flows in below the casing, and, trickling down the steam-pipe, condenses the steam before it reaches the oil-bearing rock; and where a packer is employed around the pumping and steam tubes to exclude the salt water from the oil-bearing rock, not only is this difficulty arising from condensation increased (because the steam-pipe passes through a solid column of water), but the gas which is confined below the packer creates so much pressure that it is almost impossible, in practice, to introduce steam enough to produce any beneficial results.

Another difficulty which is met with when no packer is used is this: the steam in its passage from the bottom toward the top of the well softens the slate-rock, and causes it to cave in, which necessitates clearing out the well, thus involving large expense, and materially injuring the well by suspending the pumping while the accumulation of rock is being removed, and the pumping-tube is being taken out and replaced.

My object is to obviate both of these difficulties. In the



STEAM PETROLEUM-WELLS.

drawing, A represents the oil-bearing rock, and A' A' A' the upper strata of rock and soil. B is the casing, which usually extends to such depth as will exclude the fresh water. B' is the casing-cap. C is the pumping-tube, of any usual or approved construction, and provided with the ordinary pumping-rod and valves, which need not, therefore, be described.

D is the steam-tube, extending to near the bottom of the well, care being taken to keep its lower end above such portion of dead oil or water as can not be readily removed by the pump. E is the supplementary or protecting-tube surrounding the steam-tube D, and either united to the packer F by a water-tight joint, or connected with the steam-tube D by a water-tight joint near the packer, when a packer is used, or extending through the packer. The packer F may be of any desired form.

In operating my devices, the dead oil, or oil and water, are pumped out through the pumping-tube C, in order that the discharge of steam may be unobstructed, as a small amount of either oil or water in the well will prevent any efficient use of the steam.

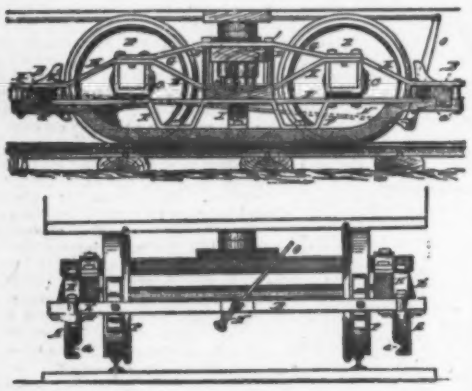
It will be seen that water which may accumulate above the packer F can not come in contact with the steam-tube D. It is further apparent that if steam be introduced through tube D into the lower part of the well, the heat and moisture thereby produced will be confined to the rock below the packer, as the water above said packer will condense the steam, which might otherwise pass up through tube E, and in case there be not enough water above the packer, a sufficient quantity to produce the desired result can be poured in from above, or the surplus steam may pass out through the tube E, and escape at the top of the well.

SAFETY DEVICE FOR CARS.

By L. O. ROOT, Minneapolis, Minn.

THE object is to prevent the cars from leaving the road-bed if the wheels should jump the rails or a rail become broken, to prevent travellers from falling under the wheels should they miss their footing in entering or leaving the cars; to assist in stopping the train should the cars run off the track.

The invention consists in a car-truck, provided with two



SAFETY DEVICE FOR CARS.

longitudinal runners A, extending from end to end of the same, one on each side outside of the wheels, the lower edges of which lie on about a line with the top line of the rails, the inner sides being grooved in such manner as to gear or engage the outer flanges of the rails should the cars run off the track, and their ends being bent up to form a rest for the brake-beam.

BRITISH REGISTRATION OF TRADE-MARKS.

THE Registration of Trade-Marks Act, 1875, has now come into operation. The following are full details of the arrangements made: The description of a trade-mark must be given in writing, and accompanied, when practicable, by a drawing or other representation in duplicate, not less than 3 inches square, on paper measuring 13 inches by 8 inches, or by pasting or otherwise fastening on such paper a specimen of the trade-mark. When a drawing or other representation or specimen can not be given, a copy or specimen of the trade-mark may be sent either of full size or on a reduced scale, and in such form as may be thought most convenient. As soon as may be, after the receipt of an application, the registrar shall require the applicant to advertise the application, stating whether that mark was or was not used before the 13th day of August, 1875. Notice of opposition may be given by sending to the registrar, together with the prescribed fees, a written notice in duplicate stating the grounds of the opposition. The registrar shall send one copy of such notice to the applicant within three weeks after the receipt, and to such notice the applicant must send to the registrar a counter statement of the grounds on which he relies for his application, or he will be deemed to have withdrawn his application. If the applicant send such counter statement, the person who gave notice of opposition must within fourteen days give security in respect of such opposition, or that opposition shall be deemed to be withdrawn. In that case any goods, which may be considered as belonging to two or more classes, and for which the trade-mark has been already registered in one particular class, a trade-mark identical with the former, or so nearly resembling the same as to be calculated to deceive, shall not without leave of the Court be registered in the name of another person with respect to the same or similar goods as belonging to another class. The registration of a trade-mark will expire in fourteen years, unless the proprietor pays the renewal fee before the expiration of such time, but he may pay it within three months after, together with an additional prescribed fee. Any trade-mark may be removed from the register after the expiration of five years from the date of the registry thereof, if the registered proprietor is not engaged in business concerned in the goods to which the trade-mark refers. Alterations may be made in all but the essential points of trade-marks. Special provisions are made respecting old and new Sheffield marks. The declarations required by these rules shall be made and subscribed in the United Kingdom before any justice of the peace, or any commissioner or other officer authorized by law to administer an oath for the purpose of any legal proceeding. The classification is based upon that adopted in the Hyde Park International Exhibition of 1851, and embraces fifty classes. A list of fees has been drawn out. These fees are to be paid by Post-office order, payable to the Registrar at the General Post-office, or if exceeding £5 may be paid by cheque in favor of the Registrar of Trade-Marks, or bearer, and crossed to the Bank of England. Cash will not be received. Copies of trade-marks will be supplied at the expense of the applicant.

UNION PACIFIC RAILROAD.

THE proportion of the working expenses to the traffic receipts of the Union Pacific Railroad declined in the year ending June 30, 1875, to 41.56 per cent as compared with 49.67 per cent in 1873–74. The mountain divisions of the line are being supplied with steel rails as fast as they can be obtained; 1015 tons of steel rails were laid down upon the system in 1874–5. The establishment of a rolling-mill at Laramie has effected a great saving in the cost of re-rolling rails. As regards sleepers, some considerable improvements have been realized; on the western part of the line large quantities of red pine ties are being used, this wood holding a spike almost equally with oak. On the eastern part of the line, oak ties are largely in use. The red pine ties cost about 50 cents each, while the oak ties cost 80 cents each. The production of coal effected at the company's mines last year was 185,681 tons, the average being $1.99 per ton.

NEW RAILROAD IN CONNECTICUT.

THIS road forms a connection at Hartford with the Connecticut Valley Railroad, which runs to tidewater at Saybrook, and at Springfield with the Boston and Albany, Connecticut River, and Springfield and Athol railroads, thereby forming, with these roads, an all-rail through-route from tidewater at Saybrook to all parts of central and northern New-England, and also a competing line with the New-York, New-Haven, and Hartford road.

The road from Hartford to the Massachusetts State line is called the Connecticut Central, and from that point to Springfield, the Springfield and Longmeadow Railroad. Both of these roads have been leased to the Connecticut Valley Railroad at the rate of 4 per cent per annum on its capital stock.

Starting from Hartford, the Connecticut Central crosses the Connecticut River over the Hartford, Providence, and Fishkill Railroad bridge, and passes through the manufacturing towns of East-Windsor, Broadbrook, Scitico, Enfield, and Longmeadow, and gives to this section of the State new railroad facilities. From Broadbrook a branch connecting with Rockville is to be built.

The road will do a large freight business, especially in coal and articles that enter into manufacturing, and in the summer a good passenger traffic. As there are no heavy cuttings and but a few bridges, the road has been one of easy construction.

It was built by Willis Phelps, of Springfield, Mass., the contract price being $25,000 per mile, exclusive of the rails. It is laid with steel rails, and fish-plate joints.

Mr. I. W. Clapp was the Chief Engineer.

[Engineering News.]

THE LONDON AND NORTHWESTERN RAILWAY COMPANY OF ENGLAND.

THIS great railway company controls 1960 miles of road, and employs 40,000 persons; it owns 391 passenger-engines, and 1544 freight-engines; its passenger traffic requires 2722 coaches, while its freight traffic demands 39,581 cars, or wagons; for the year ending June 30th, 1874, it carried 42,511,771 passengers, and 24,292,894 tons of freight; its revenue from all sources was $44,000,000. It dispatches each way over its main line between London and Rugby, daily, 64 trains of all kinds, 22 being passenger; of these, 30 express and mail trains run at 40 miles an hour; 5 run at 36 miles an hour, and the rest from 19 to 28 miles an hour. The total train mileage of all trains for the above-mentioned time was 30,558,522. Passenger-trains have increased from 312 and 403 feet in length, and 123 and 149 tons in weight in 1863, to 613 and 811 feet in length, and to 232 and 257 tons in weight in 1872. For the heavier express-trains it has been deemed expedient to use coupled engines.

To carry on the great traffic of this road, particular care is taken in the organization and training of the staff of employees, the efficiency of which is kept up by the practice of selecting men for promotion by merit, irrespective of length of time of service or any other circumstance.

In working the line, the goods-trains run with full loads between the most important stations. The traffic at the intermediate stations is collected by a service of local trains, and conveyed to centres such as Rugby, Crewe, and other junctions, there to be properly marshalled and classified, and from thence to be forwarded by the through trains without further delay. The company have 171 engines constantly employed in marshalling and classifying the trains in the sidings, which in the year mentioned performed 613,472 hours of labor in shunting, at a cost to the company of $760,000.

All English railway companies are now common carriers. The London and Northwestern Railway Company have, altogether, 1600 men and 1000 horses engaged in the goods business in London. Goods are collected, conveyed, and delivered, between all the important towns in England, within the day of 24 hours, and between England and Scotland and the ports of Ireland within two days, or 48 hours. Thus the Yorkshire merchant attends the London wool sales; he makes his purchases one day, and the wool is in his warehouse the next. The Lancashire spinner attends the Liverpool cotton market, and expects his cotton delivered, and probably in actual consumption, the next day. The dead meat from Scotland, the poultry, butter and eggs from Ireland, are all despatched with the narrowest margin of time to meet particular markets, and all is accomplished with certainty.

To keep such a traffic in motion with the regularity and system that is necessary to prevent accidents and to accomplish the ends proposed, requires the ceaseless watchfulness and activity of the staff, and the service which is performed, although not generally understood or appreciated, entitles them to high praise.

[Philadelphia Inquirer.]

DR. JOHN C. CRESSON, CIVIL ENGINEER.

DR. JOHN C. CRESSON, whose eminent usefulness made him one of the best known citizens of Philadelphia during the past forty years, died at his residence here, January 27th, 1876. He was born in this city, March 16th, 1806, and was educated at the Friends' Academy, Fourth street.

The chief service rendered this community by Mr. Cresson he performed while in the position of Chief Engineer of the Gas Works, which he held for over thirty years, although, when the proposition was first made to introduce gas into this city for illuminating purposes, Mr. Cresson, with Horace Binney, the Messrs. Sargeant, and other prominent men of that day, signed a protest against the scheme, on the ground that it was dangerous, impracticable, etc., and that the location of the works on the banks of the Schuykill would certainly kill all the fish in that river. In 1836 he became the superintendent of the Philadelphia Gas Works, and shortly afterward, upon the resignation of Mr. S. V. Merrick, who was then Chief Engineer, Mr. Cresson assumed the entire control of the works, which were rapidly developed and perfected during the thirty years in which he continued in that position. He also succeeded Mr. Merrick as president of the Franklin Institute, and retained that office for a number of years. He was chairman of the Committee on Science and the Arts of the Franklin Institute until last year. He became professor of natural philosophy and mechanics in the same institution when he was scarcely over thirty years of age.

In January, 1842, upon the reorganization of the Boys' Central High School, under Professor Bache, he was elected professor of mechanics and natural philosophy in that school. From this latter professorship he resigned, however, in October of the same year. Some time previous to this Mr. Cresson had received the honorary degree of Master of Arts from the University of Pennsylvania, of which he was for many years one of the trustees, and also the degree of Doctor of Philosophy from the University of Lewisburg.

When the Parker Commission was organized, Dr. Cresson was made one of its members, but resigned in about a year afterward to become Chief Engineer of the Park, a position he filled with great usefulness until December, 1874, when his illness compelled his resignation, and he was succeeded by Gen. Thayer, the present incumbent. Dr. Cresson's best skill as a civil engineer was fully exerted to make the Park as attractive and magnificent as possible, and his success is well attested.

In addition to the positions named above as being held by deceased, he was president of the Minehill and Schuylkill Haven Railroad, one of the managers and a vice-president of the Pennsylvania Institution for the Instruction of the Blind, and a manager of the Protestant Episcopal Hospital.

Dr. Cresson was possessed of a broad and cultured mind, and always distinguished himself in every position he occupied by rare ability and unflinching fidelity.

[Zoologist.]

THE POLAR BEAR.

THE following is extracted from the second volume of Captain Koldewey's narrative of the "German Arctic Expedition of 1874." It is the joint production of Lieutenant Payer and Dr. Copeland, the scientific naturalists to the Expedition:

"The Polar bear, which, with his yellowish white shaggy skin and black nose, forms a sharp contrast against the snow-fields at a long distance off, weighs from ten to twelve hundred-weight, and far surpasses in size those specimens in zoological gardens or menageries (which are brought over young, and developed under such unfavorable circumstances); it is surpassed by neither the lion nor the tiger in point of strength, and is quite as dangerous. But the cold zone in which it lives cools its blood; it is wary and mistrustful. The contradictory reports of their courage show that one must never judge one specimen by another, but that each individual is guided by its need of food at the moment. It lives chiefly on seals, watching for them through the ice-fissures, and falls upon them while sunning themselves, with all the cunning of the tiger and the same stealthy step. It also pursues the seal even when diving, for it is a powerful swimmer, and only the reindeer excels it in speed. Over jagged rocky declivities it climbs with cat-like dexterity. The roughness of its soles, its claws, and hairy paws insure its safety equally on smooth or sloping ice-surfaces. Payer skinned the hind feet of a bear we had killed, carefully cleaned them from all fat, rubbed them with alum, and wore them himself: they were beautiful warm stockings, for the bear had good soles. Unfortunately they were lost in a fire on board during the winter. As the seals remain chiefly among the pack-ice, or on its outer edge, so also the bear during the summer is a frequent visitor. It follows the seal-hunters step for step, in order to devour the skinned animals, or when revelling in excess swims to the carcase of a whale. The bear kills its prey before eating it, although it likes to play with it first. It rides on the floes in the Arctic current down to Iceland. It is often seen miles from land, and swims towards boats or ships until driven back by shots. When glutted with the enjoyment of fat seals, it varies its diet by ducks' eggs, and a few hours are quite enough for it to clear a small island entirely.

"It is certainly hard for the Arctic traveller to be exposed to the tender mercies of a bear's two-inch incisors; but a gun and a pocket filled with cartridges are of a much more simple process than dragging a dead seal about after one. If you are unarmed the slightest movement disquiets the bear and provokes him to action. But it is a much more serious matter to meet him in the darkness and be mistaken for a seal—a mistake only cleared up when it is too late. If you are armed, the coolness of his adversary inspires the bear with a certain amount of respect. But the bear also deserves our compassion. His life is one continued pursuit of food, although he is protected from the cold by a layer of fat several inches thick. Once we found in the stomach of one that belonged to a besieging corps (which during the whole of the winter and spring had watched the frozen ship closely, and had forced us to be wonderfully cautious), nothing but a flannel lappet which our tailor had thrown away, and in the case of many others it is quite empty. Sometimes the stomach of a dead bear contains nothing but water and large pieces of sea-weed (*Laminaria*), so that hunger compels it to eat herbs. It is certainly no trifle in this world of frost, cold and darkness, with its horrible snow-storms, that mountains only offer sufficient obstacles to his wanderings for food amidst the chaotic crowding and towering ice-fields, surrounded by fissures, or floating out to sea on an ice-floe. Certainly its brown cousin in Europe lives in luxury compared to him, and is comparatively to be envied. In the early part of the year a layer of fat, which lies under the skin in the summer and autumn, quite fails. A large male bear, killed near the ship on the 1st of April, 1870, was dreadfully lean; while a female, shot on Sabine Island, the 7th of July, 1870, was rather fat.

"With regard to the much-agitated question as to whether the bear hybernates, we could make no direct observation. But we can say at what time of year we saw them. On the 10th of January, 1870, one came to the ship and we hunted him, but he escaped; on the 13th of January, Theodore Klentzer was pursued by one; on the 6th of March, Dr. Börgen was attacked by another; afterwards they visited us daily. When I add that Copeland fought with one near Cape Borlase Warren, on the 28th of October, 1869, one may easily see that their winter sleep, if they have any, must either be very short or very disturbed. On the 9th of March we saw a bear in a storm, wandering about with powerful strides, and seeming to think nothing of the bad weather, al-

though a man, protected by the best of clothes, could scarcely have moved from the spot. The bear which we shot on the 1st of April, about three hundred steps from the ship, cost us the greatest exertions to drag away against the north wind. The smell of burnt fat draws the creatures for miles round. In their wanderings they climb high groups of ice, and one can sometimes see them looking far out, with their snouts in the air, smelling for food. The Esquimaux often catch them by it—a manœuvre which requires cleverness and self-possession—and many of them bear marks of the battle fought under such circumstances. Head wounds excepted, a shot will sometimes take away all power of resistance in the strangest manner. Meetings with bears are attended by very different results. It often happens that a party of sledge travellers, under peculiar circumstances, and with but little time to spare, pass one or more of them, sometimes but a few steps off, when they cause no other feeling than that of curiosity and astonishment. Krauschner, the engineer, was the snow-purveyor for the kitchen, and had to go twice a-day with his sledge to the neighboring glacier. Once a bear attached himself to him; he walked with dignified steps as an escort behind the sledge, and not until the engineer had reached the ship did our shout of alarm make him aware of the presence of his somewhat doubtful friend.

"On the whole, the flesh of the bear (particularly that of old animals) is far inferior to that of the brown bear; it is coarse and tough, and tastes more or less of train-oil. Barentz and many others maintain that the liver is prejudicial to health. The flesh, however, we have always found wholesome, and the Esquimaux west of Davis Straits give it to their dogs.

"Sometimes, on our sledge journeys, we were surprised in the tent; but we never set a thorough watch, chiefly because we none of us really slept, and a large creature like that could not approach without a slight rustle. A tent is to a bear thoroughly unintelligible, and an object alike of mistrust and curiosity. One of Kane's companions, who was roused by the growling of a bear and the appearance of its head through the aperture of the tent, had the presence of mind to put a lighted box of lucifer-matches under his nose, an insult which he magnanimously forgave, and disappeared at once. Our first meeting with one was on the 4th of August among the pack-ice, the day before we landed in Greenland. We had laid-to by a large ice-floe; when about three hundred steps from us we saw two bears. The burning of seal's fat had drawn their attention; for their black nozzles were high in the air, though they were shy of approaching the ship. Copeland, Sengstacke and Payer got into the boat, and, under cover of the steep floe, rowed towards them; but the newly-formed ice, which filled a creek in the floe, only admitted of Payer's landing; he shot hurriedly and missed, and they at once disappeared among the hummocks. It is not advisable to approach such a powerful enemy unless he is completely disabled. We met with bears which stood as firm as a rock against the shot, although at every bullet they quivered violently, and streams of blood flowed from them. Void of all fat and hungry, these beasts of prey haunted the coast, until upon discovering the ship the movements of the men at once drew their attention, and they never left the neighborhood of Griper Roads (the name of the winter harbor). Whoever went into the open air, though only a few steps from the ship, during the long polar night, required his gun at half-cock. One night the engineer as he came on deck heard a great rustle, and in the morning footprints showed that a bear had advanced over the snow to the tent. These besiegers also paid repeated visits to our provisions on land; but they played our astronomers the worst trick, for they carried off the measuring apparatus for the deciding the length of the base. The greatest evil for sledge-travellers is that, however important a depot they may make for provisions, they can never leave it secure from these ferœ of the ice. The best way is to hang a sack upon an inaccessible wall of rock. The strength which the bears possess in digging out any thing that is buried is astonishing. Covering over with frozen sand and water is better than the heaviest stone, because it blunts the bear's claws. In spite of their great numbers, seldom more than three (and that a family) are ever seen together. It is always well understood that the old ones must be killed first, for a she-bear deprived of her cubs is a terrible adversary. If they are only wounded, she pushes them before her or defends them with her own body, though a cub will never hesitate to devour the flesh of its mother.

"The ice-fields of its native home are pleasant to the bear, and it will not willingly part from them. The whaler Bienenkorb, which we visited in 1869, had one in a cage on deck; and when, from the strong motion from the ship, it caught sight of the ice, it began to howl dismally. Indeed the sight of the drift-ice worked so powerfully on the creature that they were obliged at last to have a veil of sail-cloth before the cage. On the 23d of August, on our return voyage, we saw through the pack-ice, half-hidden by the fog, the three last bears, and as it fell they seemed to be taking leave of us in a strange tableau."

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY. LONDON, JANUARY 15, 1876.

PROFESSOR GLADSTONE, F.R.S., President, in the Chair.—Prof. Woodward, of the Midland Institute, Birmingham, exhibited and described a novel form of apparatus for showing either the longitudinal motion of sound-waves, or the transverse vibration of those of light. It consists essentially of a series of balls suspended in a horizontal line by strings. These balls rest against a series of transverse equidistant partitions in a wedged-shape horizontal trough, which can be raised and depressed parallel to itself. If, while a ball is placed against each partition, the frame be drawn aside in the plane in which the balls hang, and then slowly depressed horizontally, the balls will be successively liberated, the order in which this takes place being regulated by the heights of the partitions. As these gradually increase from one end to the other, the appearance presented is that of a series of condensations and rarefactions, as in the ordinary acoustic wave. If the frame be drawn aside, parallel to itself, prior to depressing it, the balls will rest against one side of the trough, and can be liberated in succession, causing them to oscillate in planes parallel to themselves. By this means a vibration of the particles is set up, resembling that of poralized light.

Mr. Lockyer made a communication on "Some Recent Methods of Spectroscopy." At the outset he mentioned that he brought these processes forward in the hope that others present might be induced to take up some branch of the work. The first subject of which he treated was the photographing of the solar and metallic spectra. Mr. Rutherford, of New-York, who has produced some of the finest photographs of spectra extant, has shown that to obtain clear photographs the smallest possible portion of the surface of the prism should be employed. An excellent method for insuring this is to focus the light on the slit by means of a common opera-glass (as large as possible), which should reduce the beam of parallel rays incident on the first prism to not more than a quarter of an inch in diameter. Mr. Lockyer exhibited the 4-prism spectroscope employed by himself, to which a camera about 4 feet long is adapted. By this apparatus a large series of comparisons has been obtained between the sun and the metals, the slit employed being provided with five slides, so that the spectra can be accurately arranged side by side. It is advisable always to observe the image of the electric arc when comparing the spectra of metals with that of the sun rather than direct light. It is also found very advantageous to place the poles of the lamp at right angles to the slit, as by this means the spectra are more sharply defined than when observed in the ordinary manner; and, further, the appearances presented by the spectrum of a metal are comparable with those observed in the solar spectrum during, say, a magnesium storm. In the photograph comparing the spectra of aluminium and calcium, it is noticeable that certain lines are common to the two, but those which are thick in the aluminium spectrum are thin in that of calcium, and *vice versa*. This depends on the quantities of impurity present. It has thus been shown that there are no proper coincident lines in the spectra of any two simple substances, and that there is no substance spectroscopically pure. The relation between the lengths of the non-continuous lines, and the amounts of metals employed to produce the spectrum, convinced Mr. Lockyer that it would be possible to employ the spectroscope for quantitative analysis. The earlier experiments in this direction were then referred to, as well as those in which Mr. Lockyer has recently been engaged in conjunction with Mr. W. Chandler Roberts, of the Royal Mint, with a view to ascertain how far it is possible to detect small differences of composition in gold-copper alloys, such as that used for the coinage. The method employed consists in measuring, by means of a micrometer in the eye-piece of a 4-prism spectroscope, the relative lengths of certain gold and copper lines when the image of an induction-coil spark passing from the alloy under examination is focussed on the slit. Although the results obtained have not been uniformly comparable, and therefore reliable, it is nevertheless certain that a difference of composition as minute as the 1-10,000th part is recognizable by this means. Another branch of spectroscopic research, to which Mr. Lockyer alluded, was the study of the absorption-spectra of metals when they are not subjected to so violent an action as that of the electric arc. Observations of this nature have been made at low temperatures by Roscoe and Schuster and by Mr. Lockyer, and at the highest temperatures produced by the oxyhydrogen blowpipe by the latter in conjunction with Mr. Roberts. These experiments, which have been fully described in the *Proceedings of the Royal Society*, show that the absorption-spectra of metals may be divided into five classes, which, for any particular metal, depend on the amount of heat applied. They also show that in passing from the liquid to the most perfect gaseous state, vapors are composed of molecules of different orders of complexity; and, second, this complexity is diminished by the dissociating action of heat, each molecular simplification being marked by a distinctive spectrum.

The President inquired whether the indium line, to which Mr. Lockyer had referred, and by means of which the metal was originally discovered, was absolutely identical with the hydrogen line.

Prof. McLeod asked if Mr. Lockyer had found that the incandescence of the air made any difference in the character of the spectra, and drew attention to the advantage of a small lens placed in front of the slit.

Mr. Woodward inquired whether any mechanical means were adopted for insuring that the lamp gave a constant light while in the horizontal position.

Dr. Guthrie referred to the spectrum observed when light traverses the vapors resulting from the action of copper on nitric acid. He wished to know whether the number of bands observed stands in any relation to the number of possible oxides of nitrogen at a given temperature. Or must one oxide of nitrogen be considered as being capable, at that temperature, of giving bright and dark bands according to the way in which the light acts on it.

Mr. Lockyer, in reply to the President's question, said that, so far, no difference has been observed between the refrangibility of the hydrogen line and that of indium. He is anxious to ascertain whether any occluded hydrogen exists in the metal. Little or nothing is known as to the subject referred to in Dr. Guthrie's question. The use of the electric lamp eliminates all difficulty with reference to air lines, as its "atom-shaking" power is not sufficient to break into lines the spectra of nitrogen and oxygen. It was found necessary to make all the adjustments referred to by Mr. Woodward entirely by hand.

ANTHROPOLOGICAL INSTITUTE. LONDON, JANUARY 11.

A. W. FRANKS, Esq., F.R.S., Vice-President, occupied the chair. Mr. W. S. W. VAUX, F.R.S., read a paper on the Maori race of New-Zealand. There were three sources from which information as to the origin of the Maoris might be obtained: Firstly, from traditions, among which a very general and remarkable uniformity prevailed, pointing to the conclusion that their ancestors came from the north and north-east in small numbers, and a few at a time, the names of some of the canoes in which they arrived having been preserved. The author thought that the evidence in favor of those traditions was conclusive. Secondly, from their ethnology and customs. With regard to the former, appearances were at first sight in favor of a mixed origin, the diversities in physiognomy and color being considerable; but to that view the author held the linguistic evidence furnished an unanswerable objection. As to the customs of the Maoris, they did not differ much from those observed in other groups of Polynesian Islands, and indicated a former intimate connection between them. Thirdly, from language. The general conclusion on that argument was that there was one Polynesian language which had been broken up into many dialects, and the Maori was one of them. Thus was opened the larger question as to who were the Polynesians; and it was in that direction inquirers must seach for the origin of the Maoris. Evidence finally pointed to Asia for a solution of the problem. Dr. Hector, F.R.S., exhibited and described at length the collection of stone and other implements he had recently brought from New-Zealand, and he dwelt minutely upon the conditions of their discovery; he also entered into a discussion of the traditions of the Maoris, their population in each island, their manners and customs, their language and physique, and drew a comparison between them and the Moriories, and treated of many topics relating to the past history and present condition of the people.

ROYAL ASTRONOMICAL SOCIETY. JANUARY 14.

PROF. ADAMS, President, in the chair.—A report by the Astronomer-Royal on the progress of his new Lunar Theory was read, the object of the paper being to give such an account of the state of the work, that, in case of its being left unfinished, as unfortunately happened with Delaunay's calculations, a successor could take it up. A large portion of Sir George Airy's work—the details of which are carried out by computers under his supervision—is now completed; there remain, however, some delicate points connected with the inequalities of long period, which will require great care in their treatment, this being the most difficult part of the subject. Captain Orde Browne then made some remarks on the late transit of Venus, as observed by himself and others in Egypt, pointing out that there were three different phases of contact recorded by different observers, and that, though the difference between the times noted for the two extreme phases exceeded two minutes, yet the agreement was very striking between different observers, when due allowance was made for this. In some cases an observer had recorded more than one phase, which gave the means of determining the differences in the corresponding times. Mr. Christie described two new forms of solar eye-piece which he had contrived for diminishing the sun's light. Mr. Dunkin, one of the secretaries, then read a paper by Professor Winnecke on the late solar eclipse which had been observed at Strasburg in the same way as at Greenwich, measurements of the cusps being made with a view of determining the position of the moon. The agreement between the results obtained at the two observatories was found to be highly satisfactory. Mr. Dunkin also read a note by Mr. Webb on the variable star S. Orionis, and portions of two papers by Mr. Plummer on the "Proper Motions of Stars" and on "Astronomical Nomenclature." The former insisted strongly on the advantage that would result from rejecting the observations of the last century altogether and relying on recent determinations of positions of stars; the latter proposed a complete revolution of the mode of naming the minor planets and stars, a scheme which did not appear to commend itself to the meeting.

INSECTS IN AMBER.

DESCRIBING a collection of rare specimens of amber, to be exhibited at the Centennial by Mr. J. F. Kaldenberg, a reporter of the *Times* observed that the collection is extraordinarily rich in specimens containing remains of insects and other objects. One of the finest pieces contains a scorpion, who must have fallen into the sticky mass in a dead condition, for he has made no struggle. Often in the pieces containing insects it is easy to see by the disturbance of the substance that the little things must have fought hard for their lives, as the lines of light are broken and made prismatic for a short distance all round them. But this scorpion met his death before he was embalmed in this substance, and therefore the amber is as clear as wine. In polishing the piece, however, a part of his head suffered, and this reveals the fact that all that remains of him has become lime. He was of the small yellow variety, and not particularly formidable. The colors of the substances inclosed in this fashion still remain, for there is a small round red berry in another piece whose hue is perfect, and there is another piece which contains one of those gorgeous green and golden beetles which are found in the South-American lands, and are often used as studs and sleeve-buttons on account of their great beauty. This was a living victim and struggled fearfully, but was greatly hampered by his long antennæ, which evidently caused his ruin, like the antlers of the stag in the fable. A bee is to be seen in another piece, and is well worth study, because he presents essential differences from our bees of to-day. He has long antennæ, and a very queer proboscis, and his legs are extremely long and are furnished with spurs or thorn-like appendages from the mesothorax down to the extremities. This one died after a hard fight. A still more interesting piece shows a fragment of a cobweb, a spider, a fly, and several minute insects. The cause of grief seems to have been that the web was attached to the branch from which the tear descended and went with it. A fat dark beetle of no particular pretensions to beauty has been also preserved, and also several white moths of a fair size. Their fate is not wonderful, for they were always fluttering fools. But they struggled very hard and left pieces of themselves all over the gum. There is one fine piece which contains a drop of dew, and there is another which contains a part of a cobweb with a drop of dew on it, and a small spider. A small caterpillar was captured in one instance, and in another a caterpillar of exactly the same kind rescued himself, but left about a third of his person behind him. Then there are hundreds of specimens of small flies of every kind, some with veined wings and some with astonishingly long legs like our daddy-long-legs. There is a good specimen of an insect resembling our ichneumon fly, and there is another exceedingly like a small libellula or dragon-fly, but the wings are wanting.

The Germans, who, from their opportunities (since Pomerania has almost a monopoly of the amber trade), have made more inquiry into these facts than other nations, have examined microscopically the insects and other things embalmed in amber, and have made a catalogue of all that have been hitherto found. Up to 1860 they had discovered five crustaceans, of which the scorpion is the sole representative in this collection, thirty-three myriapoda, including centipedes and other such agreeable insects, 205 specimens of the spider kind, and of insects proper, twenty-four of aptera, sixty of hemiptera, eight of orthoptera, eighty-seven of neuroptera, and 850 of diptera.

NATIONALITY AND DISEASE.

FROM an experience of thirty years, during which 5385 deaths occurred out of over a hundred thousand lives insured, the medical directors of the Mutual Life Insurance Company of New-York have arrived at the following conclusions:

"The circumstance of nativity seems in the large majority of cases to have very little influence on the causes of death. . . . The deaths from alcoholism are chiefly among foreigners, and in the following order of nationality: England, Ireland, Scotland, and Germany.

"Consumption varies considerably; it gives the largest proportional mortality among the natives of Ireland, and the smallest among the English.

"Apoplexy gives the largest percentage among the Scotch and the smallest among the Irish, and the same holds good for diseases of the nervous system in general.

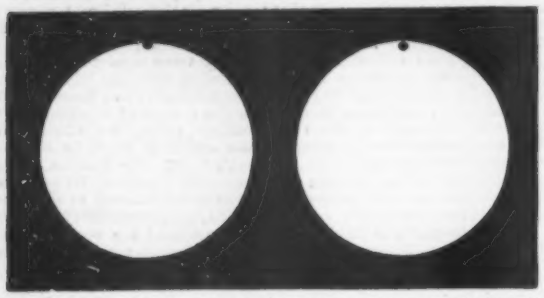
"In diseases of the digestive organs, Ireland gives the largest percentage of diseases of the stomach, and the smallest for diseases of the bowels.

"Accidental deaths occur equally among all nationalities. The native-born, the Germans, and the English give nearly the same proportion of suicides. The Irish and Scotch do not afford a single instance."

THE TRANSIT OF VENUS.

DURING the three months that the French Transit Expedition was stationed at St. Paul's Island, there was not a single day of entirely clear weather; the longest intervals of clear sky were three or four hours, and these were very rare.

On the 9th of December, 1874, the day of the transit, at three o'clock in the morning, the wind changed from north-east to north-west, suddenly producing a great amelioration in the weather. The first contact was entirely lost. A quarter of an hour after the first contact, the entire disk of Venus



THE TRANSIT OF VENUS ACROSS THE SUN'S DISK AS OBSERVED AT ST. PAUL'S BY THE FRENCH ASTRONOMERS.

was suddenly seen, marked by a pale areola, a phenomenon due in part to the solar atmosphere and in part to the atmosphere of Venus itself, which is analogous to ours, but more dense. The third contact was also observed in excellent conditions. Our engraving is from a photograph of the sun's surface, showing the transit of the planet.—CAMILLE FLAMMARION (*La Nature*).

THE SUN.

HISTORY tells us that every discovery in science, every perfection added to the methods of observation, were immediately applied to the study of the sun; solar physics made a step in advance every time that general physics made a conquest.

FIG. 1.—SUN-SPOT INSTRUMENT OF PROF. SECCHI, COLLEGE OF ROME.

The discovery of the telescope made known its rotatory motion, the existence, structure, and variation of its spots, and the manner in which light is distributed on its surface. The employment of colored glasses soon followed the discovery of the telescope. These first observations soon produced all that could be expected of them. An arrest in the progress of knowledge was the result. That branch of astronomy was despaired of when W. Herschel went to work with instruments constructed by himself; the study of the sun made great progress under him. After him came another period

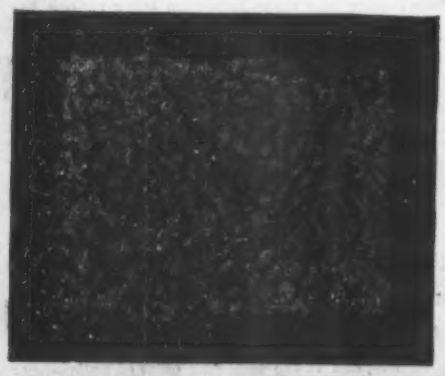


FIG. 2.—VIEW OF THE SUN'S SURFACE HIGHLY MAGNIFIED AND PROJECTED UPON A WHITE SCREEN.

of rest in that progress. Still the science of optics was advancing. But that which most advanced solar physics was the perfecting of the mathematical theory of celestial movements. Photography also added much to the study of the sun. The sun is photographed every day at present. Fig. 1 represents the instrument employed at the Roman College for those daily studies.

The perseverance with which the spots have been observed has made known the periodicity of this phenomenon. By comparing these periods of solar vicissitude with other facts, which apparently have no relation to them, it has been established that the sun does not only act as a centre of attraction and as a source of light, but that it also exercises an uncontestable action over magnetic phenomena.

Finally, spectrum analysis has opened an immense field; it has made known the chemical nature of the substances which compose the solar atmosphere, and approximately the temperature of that atmosphere. The beautiful discovery of dissociation and the mechanical theory of heat have shown us in what consists the calorific power of the sun, and explains how this power may remain the same for centuries, notwithstanding the constant radiation. The surface of the sun is not even and uniformly luminous, but undulated, granulated, and uneven. Figs. 2, 3, and 4, taken from a recent work of P. Secchi, will give an idea of the sun's surface. In special zones of the solar surface are produced spots, the number of which varies, following a periodicity of eleven years. The spots are the results of confusing action in the solar mass.

From this upheaving action there results great unevenness in the level of the sun's external surface. There are risings and depressions, which depressions form in the photosphere more or less regular cavities. The depth of these cavities is not considerable. Figs. 5 and 6 represent types of these spots, from the above-mentioned work of P. Secchi. These cavities are not empty; the resistance which they oppose to the course of the luminous currents proves that they are filled with more or less transparent vapors. The solar spots are principally produced in zones on each side of the equator, between ten and thirty degrees latitude. It was by their displacement that the rotation of the sun was discovered; but this rotation is not equal at all points of the sun's surface. The maximum angular rapidity is at the equator, and diminishes as the latitude increases. The sun does not revolve according to the laws which the movement of a solid body should present, hence we consider it a *fluid mass*.

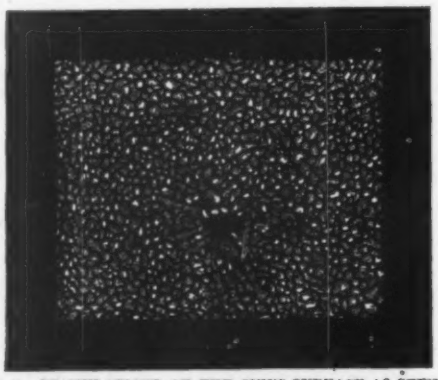


FIG. 3.—GRANULATIONS OF THE SUN'S SURFACE AS SEEN BY DIRECT OBSERVATIONS.

The primitive constitution of the sun and the formation of the planetary system render probable this supposition, that the solar body moves somewhat faster than its atmosphere. The sun is more luminous at its centre than at the border. The rapidity with which the light decreases near the border

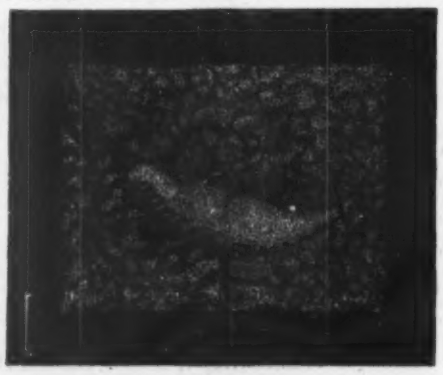


FIG. 4.—FACULÆ OF THE SUN'S SURFACE AS OBSERVED AT THE COLLEGE OF ROME.

shows that this atmosphere is very thin and absorbent. Without this absorption of the atmosphere, the sun would be like the moon, uniformly luminous on its entire surface.

The temperature, like the light, diminishes on the solar disk from the centre to the circumference. Radiation experi-

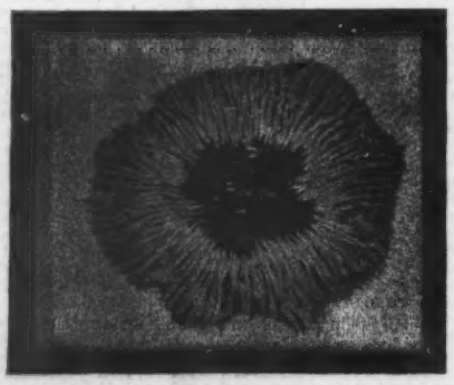


FIG. 5.—SUN SPOT OF ROUNDED FORM AS SEEN AT THE MOMENT OF ITS DEVELOPMENT.

ences considerable absorption, which increases from the centre to the circumference, where this absorption reaches its maximum. As the spots emit less light, so they also emit less heat than the other regions.—CAMILLE FLAMMARION (*La Nature*).

FIG. 6.—GROUP OF SUN-SPOTS.

ASTRONOMY.

The Comet of 1874.—The observations of Coggia's great comet, which Dr. Schmidt made at Athens, have been delayed by his absence, and are only now published in the *Astronomische Nachrichten*. It will be remembered that this comet was a very striking object near the north horizon, but in these latitudes twilight interfered much with its visibility. At Athens Dr. Schmidt was greatly impressed with its splendor, though it set earlier there, and he ranks it, in respect to brightness, length of tail, and beauty of form, as third among the many great comets which he has seen, putting that of 1861 first, and Donati's (1858) second, while those of 1843, 1862, and 1835 (Halley's) follow. The brightness of the nucleus and head, and the length of the tail, were carefully noted; the head, which on June 1st was only just visible to the naked eye as a star of 6½ magnitude, had risen by July 2d to the second magnitude, and by July 13th to 1½ magnitude, while the length of the tail had increased in the same period from a fraction of a degree to twenty-nine degrees, extending, after the head was lost in the sun's rays, to sixty-six degrees on July 21st, and thus exceeding greatly that of Donati's great comet. Dr. Schmidt has given the positions of the axis of the tail as determined by him on each night, but without drawing any conclusions as to its position with respect to the radius vector through the sun. The nucleus is stated to have been of a golden color and about a second in diameter, while the head was about three minutes of arc towards the end of the period of observation.—*Academy*.

[Chemical News.]

APPARATUS FOR THE ESTIMATION OF TANNIC ACID.

By WILLIAM THOMSON, F.C.S.

THE method devised by Müntz and Ramspacher is based on the fact that when a solution containing tannic acid is forced through well-washed untanned hide, that the hide fixes all the tannic acid, and practically allows the other matters which may be in solution to pass without being absorbed. The difference, therefore, between the specific gravities of the solution before and after passing through the hide indicates, by reference to a table, the percentage of tannin originally contained in the solution. The apparatus described by Müntz and Ramspacher is expensive, and the time required to have one constructed would no doubt be considerable, so that it would not be worth while for chemists who have not a somewhat regular practice in the analysis of tannin materials to go to the trouble or expense of having such an apparatus made. The principle of their contrivance consists in enclosing the fluid to be tested in a short metallic cylinder open at both ends, the under end being covered by a piece of the untanned hide, the upper by a strong piece of vulcanized sheet caoutchouc. These are clamped firmly together by screws, and by means of a screw to which is attached a rounded metallic disk, pressure is brought to bear on the caoutchouc, and the fluid thus forced through the hide.

The contrivance which I have devised for this purpose, which answers perfectly, and may be made altogether in about an hour, is the following:

Two strong ground-glass funnels with rather wide stems are taken, a circular piece of hard wood fitted on each (as shown in the drawing), the bottom part of which comes within the eighth of an inch from the top of the funnel; four holes are made through the wood, into which are inserted four ordinary long iron screws fitted with nuts; the hide is placed between the two funnels, the screws passed through the holes in the two pieces of wood, the nuts screwed on and tightened equally all round by a key; a funnel with a thin stem is then inserted into the larger stem of the top funnel and the liquor poured in; the stem of the under funnel is passed through an india-rubber cork fitted into a flask; the flask is attached by another tube penetrating the cork to a Bunsen's vacuum pump, and vacuum made and the liquor allowed to filter slowly through. Quicker filtration may be produced by applying pressure above and suction below, by completely filling the upper funnel with liquid, attaching to its stem by strong caoutchouc tubing a long tube ending in another funnel (as shown in the engraving) and filling the tube and other funnel with liquid; or the pressure by this means may alone be employed.